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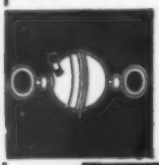

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The Victoria History of the Counties of England

WHEN in the early months of the present year the one hundredth volume* of the Victoria History of the Counties of England issued from the press, it marked a memorable achievement, in which all who have been associated with the work may feel a legitimate pride. Inevitably this feeling is mingled with regret that so many among the promoters and the collaborators of earlier days cannot now enjoy the credit that is their due—not least among them the one man, the late Dr. William Page, to whose courage, tenacity of purpose, and organizing ability we owe it that this great undertaking is still in existence to pursue its way towards completion.

The Victoria History of the Counties of England was conceived on a generous scale ; and when the original promoters came to work out their plan in detail, the magnitude of the task they had undertaken might well have daunted the boldest. Something of its stupendous character, the organization involved, and the difficulties to be overcome, of which not the least has been finance, may be gauged from the fact that in just under forty years less than one half of the work has been completed.

The conception of a new history and survey of the counties of England to supersede the partial, out-of-date, and often unsatisfactory records existing in the closing years of the last century was due to Mr. (afterwards Sir) Laurence Gomme, whose genius as a research worker in the remoter fields of the social history of the English people was equalled only by his vision in the co-ordination of learning in the study of the past, and his power of inspiring others with an enthusiasm like his own. The survey was planned to cover the natural features, the geology, natural history, the archæology and social history, in the broadest sense, of each county ; but its essential feature, and as it were its mainspring, was to be the topographical record, a detailed descriptive and historical account of town, village and hamlet, not only including important historic buildings, but also omitting no feature of historic, antiquarian or architectural interest. For example, the record covers those important factors in the development of English social life, the manors, tracing their history in the various families that have held them, not omitting to give consideration to the heraldry of these, as well as of the other important families of the county. The most casual glance through the pages of the hundredth volume, covering the topography of a division of Sussex, will serve to indicate how faithfully, and with what competent completeness, the original scheme in this department of the work has been respected and carried out. Not only has care been lavished on preparation to ensure accuracy of detail, but also every effort has been made to ensure that no least item of interest or significance should escape notice. Needless to say, county records have been ransacked for rare and usually inaccessible documents, plans, maps and illustrative material which might serve to illuminate past history. The scale of the work and the labour involved in its preparation may be estimated from the fact that the record of no county will be completed in less than three volumes, several run to nine, while one, Norfolk, will require ten volumes. One volume is to be given to Roman England.

* The Victoria History of the County of Sussex. Edited by L. F. Salzman. Vol. 9 : The Rape of Hastings. (The Victoria History of the Counties of England.) Pp. xv+279+63 plates. (London : Oxford University Press, 1937). 42s. net.

It is of interest to note the origin of the title of the History. When permission was sought to dedicate the project of providing a history of every county of England to Her Majesty Queen Victoria, its importance was at once recognized by her. Not only did she graciously accept the dedication, but she also commanded that the history should bear her name. A like patronage has been extended to the work by her successors. Each in turn has expressed sympathetic interest in its progress; and on the occasion of the celebration of the publication of the one hundredth volume, Lord Athlone, as Chancellor of the University of London, read the following message from H.M. the King:

"The King has learned with much satisfaction of the publication of the hundredth volume of the Victoria County History, which you are celebrating. His Majesty cordially congratulates all concerned in this notable achievement and desires to assure you that he fully shares the interest evinced by his predecessors in the progress of the work."

The scheme for this boldly conceived county survey was successfully launched by the publication of the first volume of "Hampshire" in 1900, Mr. H. A. Doubleday being the editor. Two years later Mr. W. Page was joined with him, and in 1904 became sole editor, continuing to act in that capacity until his death in 1934. This long period of office was one of many vicissitudes and anxieties. In the first four years of his editorship, between 1904 and 1908, Mr. Page accomplished the remarkable feat of publishing no fewer than thirty-nine volumes of the History, to which professional and lay workers extended a cordial welcome for its accuracy, scholarship and technique of production. At this point, however, financial difficulties began to press, and the rate of publication slackened until, with the outbreak of war in 1914, the work came to a standstill.

At the close of hostilities, the position of the History offered little prospect for the future. The efficient staff which Mr. Page had collected and trained had been dispersed, and the affairs of the History lay in Chancery, until the late Lord Hambleden came to the rescue, purchasing all assets and rights, which he handed over to the editor in 1922. Nothing daunted by the difficulties which confronted him, Mr. Page set to work, and in the next ten years published eighteen volumes, relying for his financial resources on what could be raised for the production of each volume in turn. In 1932, however, feeling the burden of his years and anxious to secure the continuance of the work, he offered the History to the University of London. The gift was accepted, and since then publication has been carried on by the University, the work of administration being entrusted to the Institute of Historical Research.

Although the continued existence of the History is assured by its transfer to the University of London, it by no means follows that all difficulties standing in the way of that steady and rapid progress towards completion, which is essential to its value as a record, have been smoothed away. As chairman of the University Court, Lord Macmillan, pointed out on the occasion of the celebration to which reference has already been made, while the University holds itself responsible for general expenses, including a too exiguous staff, it is not in a position to bear the burden of payments to contributors and costs of production, which up to the present have exceeded the income from sales by, on the average, a sum of £700 for each volume. At present the University does not feel justified in commissioning a new volume until it is assured that such a sum will be made good by public and private benefaction. It is, however, to some extent reassuring to note that, at the time this statement was made, the authorities had put in hand the preparation of seven new volumes. For these volumes, adequate financial assistance has been secured; but continued publication depends upon further support.

For a work of the character and scope of the Victoria County History, it is obvious that the ordinary channels are of little avail. No doubt as the value of the work is more widely recognized, larger sums will accrue from its sale. The present tendency towards an increased interest in local antiquities and history among the public justifies such an assumption; and the appearance of the County History on the reference shelves of public libraries in the more important centres of population will be expected as a matter of course. Nor doubtless will the private benefactor ever be entirely lacking. But it cannot be anticipated that these sources will be adequate to meet the needs of publication without substantial backing from the public purse. That a more liberal flow of funds from this source is to be anticipated is indicated by recent action of the Minister of Health. He has announced his willingness to sanction application from local governments for leave to make grants for the completion of histories of areas within their jurisdiction. Substantial help

under the provisions of this announcement has already been received from several local government bodies, including the County Council of Warwickshire, and the City Councils of Birmingham, Coventry, and Oxford. This example might, and no doubt will, be followed liberally by other local councils in due course.

There are, however, a number of reasons for urging that a publication doing work such as that which the County History might carry out, given a more rapid rate of publication, is of national and not merely of local interest, and should be subsidized from national funds; just as, in the instance of an ancient monument, it has not infrequently occurred that its importance as a piece of historic evidence of national interest has justified a nation-wide appeal for funds for its preservation. There can be no two opinions that it was a calamity that publication of the Victoria County History had not been completed before the outbreak of hostilities in 1914. If the contemplated county survey had been complete then, it would present a unique summation of the development of English culture at a time when, had we but known, it was about to suffer a fundamental transformation. Although we have it now but in part, it is no less important that we should have as its pendant a record at the present time, when the character of the English countryside is changing before our eyes. Time is the essence of the contract, and it is desirable in the extreme that the record should be made before these changes have gone too far on their way. No doubt local interest, in the long run, will ensure that in due course each county history will attain completion; but as a national undertaking—and the Victoria History as a whole is no less—the value of the survey resides to a great degree in the extent to which it can present a series of contemporary pictures giving in sum a record of the cultural development of England as a whole. This is a work of educational value to the entire nation, both now and future generations, and as such is one which national resources might be asked to subsidize, apart from the contribution of local funds. It is true that it may be urged that, in respect of evidence of antiquity still standing, the obligation of national funds is met by the work of the Historical Monuments Commission. However valuable the work of that Commission may be as a record, it cannot give the facts their natural and cultural setting. It is this setting which eventually, when the Victoria County History is complete, will endow it with abiding value.

The Botanical Gardens, Leyden

1587-1937 Hortus Academicus Lugduno Batavus The Development of the Gardens of Leyden University. By H. Veendorp and L. G. M. Baas Becking. Pp. 218. (Haarlem: Typographia Enschedaiana, 1938.)

A CERTAIN amount of confusion exists in the minds of some botanists concerning botanical gardens, especially with reference to their origin and history. This is probably due in no small measure to a misunderstanding of the term. Botanical gardens may be considered to be gardens in which the plants are deliberately arranged according to botanical classification, and where plants are grown and studied from the point of view of their botanical and economic importance. In this way such a garden differs widely from a park. The former has as its primary objective, botanical research and education: the latter, that of beauty and recreation. The fact that the objectives in nearly all cases overlap is immaterial.

Failure to recognize the distinction between a botanical garden and a park probably explains the difference of opinion concerning the Vatican Gardens. Some claim that these gardens are the oldest existing botanical gardens in the world, since they were established by Pope Nicolas III in 1277. Since that date, their location has been changed several times, the present-day Gardens being founded in 1883 at the foot of Janiculus. They are twenty-seven acres in extent. Botanists who claim these Gardens as the oldest botanical gardens do so on the grounds that a small portion of them was used for pharmaceutical and experimental purposes. Others point out that the Gardens were founded by Nicolas essentially as a recreative park. Thus the experimental side was merely a side issue.

One of the first botanical gardens of which there are authentic records was the Royal Garden founded by Thotmes III at Karnak in Egypt more than three thousand years ago. The plants cultivated there were probably of utilitarian value. Another early garden established with the express purpose of aiding the study of plant life was that founded by Aristotle in the fourth century B.C.

and placed under the direction of his pupil, Theophrastus.

The immediate precursors of the present-day botanical gardens of the world were the physic gardens of the monasteries and convents. Their contents were determined chiefly by therapeutic and culinary value. Herb-lore was the prerogative of the layman, but the more systematic study and cultivation of plants of proved medicinal value remained with the cloister gardens.

Later, plant drugs and even living plants began to seep into Europe from the Near East, and in the early sixteenth century the science of pharmacognosy became established in Pisa (1543), and Padua (1545), where medicinal gardens attached to the Universities were established. The founder of the Pisa garden was Prof. L. Ghini, but the gardens achieved greater fame under their second director, Andrea Cæsalpini, whose work marked the beginnings of present-day systematic botany. In Italy, other botanical gardens followed Padua, among the best-known of which were Florence (1556), Bologna (1657) and Rome (1660).

The Jardin Royal des Plantes Medicinales was founded in Paris by Guy de la Brosse, the king's physician in 1635. Its present name, Musée d'Histoire Naturelle, was given to it in 1790.

The Chelsea Physic Garden was established in London by the Society of Apothecaries in 1673. It was established for the study and teaching of botany and for providing material to that end, and was extended by Sir Hans Sloane in 1722. It was handed over to a committee of management for botanical research in 1902.

Schöneberg, near Berlin, was the scene of the foundation of the Staatliche Botanische Garten und Museum in 1679: but during 1897–1907 the garden was transferred to its present site in Berlin-Dahlem. It is now about 100 acres in extent.

The world-famous Royal Botanic Gardens at Kew, Surrey, of an area of 288 acres, are a much younger institution. Plants grown by Lord Capel of Kew House formed the nucleus of the Gardens, and in 1757, William Aiton, a former student in the Chelsea Physic Garden, was appointed to extend this nucleus also as a physic garden. But the Gardens were not established as a national garden until 1841, under the direction of Sir William Hooker.

Last year, the Botanical Gardens of the University of Leyden celebrated their three hundred and fiftieth anniversary, which is of special interest since Dutch botanists and Dutch botanical gardens have had an exceptionally important role in the development of botanical science throughout the centuries. The names of Leeuwenhoek, Swammerdam, Ingenhousz, van Marum and Hugo de Vries are sufficient to establish claim to pre-eminence in this field. Furthermore, apart from the Gardens at Leyden, there are several others of first importance, such as those at Amsterdam, where de Vries carried out his epoch-making genetical experiments on *Œnothera*. Furthermore, the wonderful collections in the Gardens at Buitenzorg in the Dutch East Indies are known to all present-day botanists. These Gardens were founded by C. G. C. Reinwardt, who was director of the Leyden Gardens in the early eighteenth century.

Even to-day, botanists are much indebted to Holland, and especially Amsterdam, The Hague and Leyden, for the advancement of their science. Botanical research is very healthy in that country; its present botanical publications include *Chronica Botanica*, under the editorship of Dr. Verdoorn, which is international in its scope, and many other journals and also books of more specialized interest. Now comes the commemoration volume of the Botanical Gardens at Leyden, which is of interest not to botanists alone but also to other men of science.

The University of Leyden was founded in a monastery in 1575, but owing to lack of space the establishment of a medicinal garden was deferred. Later, the municipal council granted an extension of land and the Gardens were established in 1587. The professor of medicine, Geraerdt de Bont, was offered an increase in salary of fifty guilders "if willing to continue as well in winter time to explain and administer anatomy, as in summer to explain the herbs to students of medicine".

In 1589, de Bont was succeeded by Pieter Pauw as professor extraordinarius of medicine. Owing to internal dissension, however, little was done for the Gardens, and in 1592, Clusius (Charles de l'Escluse) was appointed. It was Clusius who foresaw the great importance of plant bulbs.

The first inventory and plan of the Gardens were made in 1594. The Gardens were divided into four quadrangles by intersecting paths and contained more than a thousand different species. Though no particularly systematic plan was followed at that time, the "Index" of 1594 was that of a *hortus botanicus* rather than a *hortus medicus*, showing that the Gardens were an expression of Clusius's purely botanical point of view.

The first printed catalogue of the Gardens appeared in 1601. In 1685, there were three thousand species in the Gardens: in 1740, seven thousand: and at the present time there are between eight and nine thousand.

The 1628 catalogue owed its existence to the fact that the then director, Adolf de Vorst, was asked to show "more activity and application". The catalogue of 1633 showed the appearance of several North American species, the centre of distribution of which was Paris. It is characteristic that the most common specific name applied to

these plants by the French was *canadensis*, by the British, *virginicus*, and by the Italians, *indicus*. Among other introductions were the Virginian creeper and the Jerusalem artichoke.

Herman Boerhaave was appointed director of the Gardens in 1709. He has been described as "a Physician and plant-lover by the Grace of God, Professor of Chemistry and of Botany by the Grace of the Board of Curatores". Among his botanical correspondents were William Sherard and Hans Sloane. It is interesting to note that when considering his successor in 1729, Boerhaave had in mind Scheuchzer of Zurich and Dillenius of Oxford, but since neither was a chemist both were rejected, and A. van Royen was appointed.

Linnæus visited the Botanical Gardens at Leyden for the first time in 1735. He formed a close connexion with the Gardens, and dedicated his "Genera Plantarum" to Boerhaave, who wrote of the work, "centuries shall praise it, the good will follow it, all will derive profit from it". The human element comes in when we read that in order to coax Linnæus, Boerhaave offered him a two-year plant-collecting trip to the Cape, but Linnæus declined it since he had a bride waiting for him in Sweden.

With a further succession of directors, the Gardens continued in prosperity, and many more species, especially of Japanese origin, were acquired. In 1891, Jacobus Janse was appointed to the chair, where he did forty years of splendid work. He retired in 1930 and has only recently died.

The Gardens are now under the directorship of Prof. L. G. M. Baas Becking, co-author of the work under review. His is a splendid heritage. In the Gardens of to-day, periods of architecture and centuries of endeavour are reflected. But there is no fear for the future of the Gardens. They are in good hands, as reflected in Prof. Baas Becking's concluding words in this monumental book: "We have cause to be contented, *but we should take care lest we be satisfied*."

The authors of this book, H. Veendorp, *hortulanus*, and L. G. M. Baas Becking, *praefectus horti*, are to be congratulated on a work of inestimable value to botanists; for apart from an absorbing history of one of the most important of botanical gardens, we are offered a wealth of botanical information of more general appeal.

The text is beautifully illustrated with sketches by J. Spier, D. A. Bueno de Mesquita, J. Raphael and Miss M. L. E. van Weydom Claterbos.

Data of Ferromagnetism

Magnetische und elektrische Eigenschaften des Eisens und seiner Legierungen

Von Dr. O. v. Auwers. (Aus "Gmelins Handbuch der anorganischen Chemie", herausgegeben von der Deutschen Chemischen Gesellschaft.) Pp. lxii + 1421–1634 + 466 + 148. (Berlin: Verlag Chemie, G.m.b.H., 1938.) 84 gold marks.

TWO parts of "Gmelins Handbuch" dealing with the magnetic and electric properties of iron and its alloys have previously been published, the first dealing with 'pure' iron and the iron-carbon system (1934), and the second with alloy steels (1936). These are brought together in the present volume, with a supplement covering the literature up to September, 1937.

Magnetic and electric properties are surveyed in separate sections in each part, the magnetic sections accounting for about three quarters of the whole. The first part opens with an introductory section dealing with definitions and units, and in a general way with theories of ferromagnetic phenomena. Most of the experimental material is presented under the main headings of intensity, susceptibility, and hysteresis. The effects of form, grain size, thermal and mechanical treatments, temperature, strain, and alternating fields are reviewed under each heading. Further sections deal with the Barkhausen effect, magnetostriction, and galvanomagnetic effects. The survey of electric properties includes sections on resistance, contact potentials, and thermo-electric effects. In the second part, some six hundred alloy systems are treated in turn in the Gmelin system order at a length ranging from that of a treatise, as for the magnetic properties of the iron-silicon and iron-nickel systems, to that of a bare reference.

Apart from a number of general literature lists, the references are incorporated in the text, to the number of tens of thousands. The text is largely a guide to the literature, either without comment, or with brief abstracts, supplemented by general surveys introducing many of the sections. In spite of the necessity for conformity with a rather rigid plan, the author of the text has succeeded remarkably well in infusing a measure of spontaneity into the presentation, and a profound familiarity with the subject-matter is shown by the easy conciseness and clearness, and by the appositeness of cross-reference and footnote.

Extensive numerical data and numerous diagrams are given, these forming one of the most valuable features of the work.

With the general scheme of arrangement of the "Handbuch", based on the subdivision of subject-matter by substances, reference to the work done on any particular alloy is very straightforward. Reference for other purposes is facilitated by summaries at the ends of the second and third parts indicating under which alloys the more important phenomena are discussed, and by extensive tables in which the alloys are arranged in accordance with their properties. There are also lists of patented alloys, similarly arranged, and of the compositions of alloys having special trade names.

It is for the unprecedented comprehensiveness of the survey of ferromagnetic properties that this volume is particularly valuable. As a treatise on ferromagnetism it inevitably suffers from the fact that nickel and cobalt cannot be considered except as constituents of alloys, and that the theoretical side can be considered only incidentally. As a record of experimental data, and as a guide to the literature, however, it is in a class by itself. It will be invaluable not only to chemists, but also to physicists concerned with magnetism, to metallurgists, and to electrotechnologists.

Examination of this volume focuses attention on the overwhelming mass of experimental work which has been carried out on ferromagnetism, against which understanding of ferromagnetic phenomena is revealed as still pitifully meagre. It is difficult to avoid the feeling that if even a small fraction of the energy devoted to the accumulation of experimental data had been diverted to serious theoretical investigation, a much more satisfying state would have been reached not only in the science of magnetism, but also in the associated practical art. E. C. S.

Castelnuovo's Collected Works

Memorie scelte
Per Guido Castelnuovo. Pp. x+588. (Bologna: Nicola Zanichelli, 1937.) 125 lire.

PROF. CASTELNUOVO'S scientific jubilee occurred in the year 1935; and in the same year he retired from the professorship of geometry at the University of Rome, a post which he had held for nearly forty-five years. To mark the occasion, his friends and pupils urged him to publish a book of memoirs and decided to found, in his name, a scholarship at the University, to which the proceeds from the sale of the book should be devoted. After some delay, the book has now appeared. Containing as it does most of Castelnuovo's major works, it needs no introduction to students of algebraic geometry, who at one time or another find it necessary to consult all of them. Its value is enhanced by the fact that, here and there, the author has added brief commentaries of great interest, showing the relations between the various papers and giving some account of their inception.

The present book opens with a series of papers representative of the author's work during the early Turin period (1887–91) when he was in daily contact with Corrado Segre. It has been said that the modern geometry of curves was born under the arcades of Via Po, Turin, the fruit of conversations between the two young mathematicians. In proof of this, the second paper of the series contains the celebrated result concerning the maximum genus of a curve in a given space. These researches culminate in a long memoir on plane curves which may be said to initiate the modern study of linear systems from the invariantive point of view. To Castelnuovo we owe the introduction of those *virtual* characters which play a leading part in all later developments.

The second period, which begins with Castelnuovo's appointment to the chair of geometry at Rome, is remarkable for the wealth of results and for the unity of aim displayed throughout. The years 1892–97 saw the creation, in the theory of algebraic surfaces, of a vast new branch of geometry which is almost entirely the work of two men, Castelnuovo and Enriques. Castelnuovo's own contribution to it was a long chain of memoirs which dispose of an array of important problems, many of them landmarks in the theory. The whole of this work is characterized by the utmost originality and resourcefulness; the author has had to forge his own technique for each special problem.

First comes a number of preparatory notes which discuss various simple types of rational surfaces and criteria of rationality. These, it now appears, were almost prophetic, for they were destined to be invaluable in the general discussion which almost always reduces, in the last analysis, to the examination of particular cases. Then follows a

group of famous memoirs on the rationality of plane involutions, the conditions of rationality of a surface, and an exhaustive study of linear systems of curves on a surface, with all the remarkable inferences which can be drawn from it. So intense was this period of research that few fundamental questions remained to be settled afterwards. One of them, however, was disposed of only a year ago, by Beniamino Segre.

In the ensuing period the author's interest turns from the methods of algebraic geometry proper to the consideration of transcendental questions. The most celebrated paper of this group contains the theorem that the number of simple, everywhere finite integrals attached to an algebraic surface is equal to the so-called irregularity of the surface. This third series concludes with some interesting researches on Abelian functions. The final paper is devoted to a very different topic—the statistical problem of moments.

To anyone with a knowledge of Italian, though not necessarily of geometry, these papers will have an extra-mathematical interest: they are written in a style which for sheer lucidity and directness has never been surpassed. Castelnuovo has that rare capacity for going straight to the heart of a difficult problem, of seeing where the difficulty lies, and resolving it in successive stages, all apparently of the utmost simplicity. Altogether, this book is the most fitting memorial to the great period of Italian mathematics which now, it seems, is drawing to a close.

Laboratory Experiments in Biochemistry

Fundamentals of Biochemistry, with Laboratory Experiments

By Prof. Carl L. A. Schmidt and Dr. Frank Worthington Allen. (International Chemical Series.) Pp. xv+388. (New York and London: McGraw-Hill Book Co. Inc., 1938.) 18*s*.

THIS is a book for the beginner in America. It starts with a definition of the purpose of laboratory training which every old stager in science will applaud. "The incalculable gift of the laboratory is its discipline in scientific method and its training in the importance of logical reasoning and the use of exact language in speaking and in writing." The student is enjoined to supply himself with a laboratory coat, a box of matches, a set of weights, a note-book and a slide rule. So equipped, the scientific world lies open before him.

The standard of biochemistry and chemical physiology is so high in the United States to-day that one may justly infer that the subject is being well taught, particularly in the laboratory. The object of the special experiments here described is defined as "to teach the student the sources of the facts of biochemistry, to integrate information, to carry out a well-controlled experiment and to present the facts in a co-ordinated and logical manner".

There is no doubt that the object is the same in Great Britain also, but any time when half a dozen employers are gathered together, they will tell you that the normal product of the British university definitely fails to meet such criteria. The question may justifiably be asked whether our present training is not too theoretical? As has been aptly written by Dr. S. Miall, "We should not regard the young as carboys into which you can put pints or litres of knowledge". For the moment the fight against examinations as the one test of education appears lost or in abeyance; there are but few reformers left to combat in this field. The fact remains, however, that in many respects the Americans are better trained, more practical to-day than British graduates; it is evidenced by the way the United States is going ahead in scientific work and, what is more important, in its practical application.

It is opportune to sound this warning note, and to express the hope that teachers in Great Britain will examine with care books such as this one, so that they may ascertain the difference between British and American methods.

This is not the place for its detailed examination; there is no novelty in the experiments or in the facts presented in its text, which is crisp and contains a great deal of information in a small compass. Its perusal leaves us with the feeling, rightly or wrongly, that it would inspire a young man to dig further into the subject and try to keep abreast of its progress. The essential facts are clearly presented whether the substance is simple or complex in structure.

"Further, deeper may you read,
Have you sight for things afield,"

says Meredith. Surely it is in this spirit that the training of men whose work takes them near to Nature should be conducted.

E. F. A.

(1) Experimental Cookery:
from the Chemical and Physical Standpoint; with a Laboratory Outline. By Prof. Belle Lowe. Second edition. Pp. xi+600. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1937.) 22*s.* 6*d.* net.

(2) Food Technology
By Dr. Samuel C. Prescott and Prof. Bernard E. Proctor. Pp. ix+630. (New York and London: McGraw-Hill Book Co., Inc., 1937.) 30*s.*

(1) THE object of this book is to present the knowledge of food preparation and cookery processes from a chemical and physical point of view, particularly from that of colloid chemistry. A citation from Ostwald is appropriate: "Much as everyone would like to obtain better food for less money, the study of such questions is regarded as menial and best left to the cook. A scientific study of the preparation of food is considered as only amusing in scientific circles."

The book is intended for students of home economics and for food preparation courses in colleges. It is highly informative and in advance of most other books on the subject.

(2) This book, of American origin, is designed for students who hope to find a place in the food industries: it seeks to bring into a single volume the laws and processes of biology, physics, chemistry and engineering used in the preparation and preservation of food products. It is certainly a mine of information brought together in a congested form but written with a light touch so as to make interesting reading.

The staple foods are dealt with in turn: cereals, sugar, vegetables and fruits, of plant origin; meats, dairy products and fish, of animal origin. Half the book is devoted to the processes of food manufacture. It may be claimed that full knowledge is available how to prepare first-class foods of all types under hygienic conditions so that there is no excuse for delinquents, who should be severely dealt with. It is for the public to select a proper diet in relation to their means and for the dieticians to explain why we must have fresh food also.

Mœurs et histoire des Peuls
1: Origines; 2: Les Peuls de l'Issa-Ber et du Macina; 3: Les Peuls du Fouta-Djallon. Par Louis Tauxier. (Bibliothèque scientifique.) Pp. 422+16 plates. (Paris: Payot et Cie., 1937.) 75 francs.

THE Peuls, as they are known to the French authorities, who have adopted the Wolof name, but more commonly known in English as the Foula or Fulani, are a pastoral people, widely scattered as a dominant caste over that part of northern Africa extending from Nigeria to Senegal and from the Atlantic to Lake Chad. They were known to Arab writers of the fifteenth century; but they appear to have reached northern Nigeria as an immigrant nomad people at the end of the thirteenth century, their conquest of that country, however, dating from 1804 when the Moslems declared a Holy War against the pagan rulers. In French territory their principal groups are Peuls of Fouta Toro (Ferlo), of Nioro, of Macina and Fouta Djallon, their numbers being estimated at 1,790,000, while in Nigeria there are said to be some two millions.

Various theories have been put forward as to their origin, some of a fantastic character. It is now generally accepted that they are of southern Hamitic origin, while their language is an archaic Hamitic tongue.

M. Tauxier, whose opportunity of observation in the field among the Peuls extended over many years, here presents a critical survey of the information relating to them, and discusses critically the literature dealing with their origins, social organization and history, which he analyses in the light of his personal studies. His work, more especially in regard to the people bordering on the Niger and of Fouta Djallon, is the most complete study which has yet been made.

Analytic Geometry and Calculus
By Prof. Max Morris and Prof. Orley E. Brown. Pp. x+507. (New York and London: McGraw-Hill Book Co., Inc., 1937.) 21*s.*

THE authors of this volume have taken for their aim the axiom that the best preparation for the calculus is a suitable course in co-ordinate geometry. The text is thus divided into two sections: the first, consisting of six chapters, is devoted to analytic geometry, and the second to the calculus. The former embraces both plane and solid geometry and deals not only with the conics, but also with cycloids, exponential and logarithmic curves, together with several curves of historical interest like the Cassinian Ovals. The section on calculus begins with a discussion of limits, continuity and derivatives. Then follows a sound exposition of integration, partial differentiation, multiple and line integrals, infinite series and finally a chapter on differential equations.

The book abounds in exercises for the student, both of the academic drill type and of the more practical problematic kind. The text is also excellently illustrated with clearly drawn diagrams. Although the book is adapted to the needs of American students, it should be of much value in Great Britain.

Ixodoidés
Par Prof. G. Senevet. (Faune de France: 32. Fédération française des Sociétés de Sciences naturelles: Office central de Faunistique.) Pp. 101. (Paris: Paul Lechevalier, 1937.) 50 francs.

THIS useful synopsis deals not only with the French species but also with those found in countries bordering on the Republic. Since the various species found in Great Britain are also included, this work provides a handy and ready means for their identification. In addition to the descriptions of each of the species enumerated, an account is given of its range of distribution, its hosts and its pathological relations. At the end of the work a list of hosts is appended, arranged in taxonomic order, together with the various Ixodidæ known to parasitize them. Prof. Senevet has written a memoir which may be recommended as being well up to the high standard attained by others in the series to which it belongs.

The Atmospheres of the Planets*

By Dr. H. Spencer Jones, F.R.S., Astronomer Royal

DURING the last few decades, the main interests of astronomical research have shifted rapidly from the solar system outwards. Nevertheless, the planets have not been entirely neglected in recent research. The great light-gathering power of large modern telescopes has enabled spectrographs of very high dispersion to be used for the more detailed study of the spectra of the planets, and the great advances in the manufacture of plates sensitive to the infra-red region of the spectrum have made possible the investigation of a region of the spectrum the importance of which arises from the fact that the selective absorptions by planetary atmospheres lie mainly in this region.

From theoretical considerations it is possible to decide whether or not any planet may be expected to possess an atmosphere. The natural tendency of an atmosphere is to diffuse away into space. In order to overcome the gravitational pull of the planet any particle, whether large or small, must acquire a velocity greater than a certain minimum value, determined by the mass and radius of the planet.

The rate at which this loss of fast-moving molecules from the upper atmosphere takes place depends upon the relative magnitudes of the velocity of escape and of the mean velocity of the molecules. Jeans found that if the velocity of escape is four times the mean molecular velocity, the atmosphere would be practically completely lost in fifty thousand years; but if the velocity of escape is five times the mean molecular velocity, twenty-five thousand million years would be required for the loss to be almost complete. If therefore the velocity of escape is as great as five times the mean molecular velocity of hydrogen, the atmosphere will be practically immune from loss.

The velocities of escape from the moon and from Mercury are not much greater than the mean molecular velocity of hydrogen, so that an atmosphere of hydrogen would escape almost instantly from either body. It appears that the moon, if it had never been hotter than at present, would have lost water vapour, nitrogen and oxygen completely, but would have retained carbon dioxide and heavier gases; Mercury, under the same supposition, would have lost almost all its water vapour and nitrogen and most of its oxygen, but would have retained heavier gases to a large extent. The loss is likely to be under-estimated because, during the initial rapid cooling, the loss must have been considerable. It is certain that the moon has no atmosphere now. The evidence of an atmosphere on Mercury is not fully conclusive, but the opinion of Antoniadi that Mercury may possess a very tenuous atmosphere is not in conflict with the theoretical evidence.

The Earth

Coming to the earth, the escape velocity is 11·2 km./sec., which is almost exactly six times the mean molecular velocity of hydrogen at 0° C. Hence the atmosphere of the earth should be immune from loss of hydrogen and all other gases. At the present time, the amounts of hydrogen and of helium in the earth's atmosphere are very small. The supply is being gradually replenished by the weathering of the igneous rocks of the earth's crust, which contain uranium and thorium and also consequently helium. Yet the atmosphere does not now contain more than a fraction of the amount of helium that it has gained in geological times. There is thus direct observational evidence that helium is being lost from the atmosphere at the present time.

There is one process by which the escape of helium can be brought about. It is well known that the night sky is faintly luminous. In the spectrum of the night sky the characteristic green auroral line, as well as the two red lines, are always present. These lines are emitted by oxygen atoms that are in what physicists term a metastable state. The atoms in a metastable state may remain for an average time of a second or longer in that state before emitting their energy in the form of radiation. There is a high probability that before this occurs the atom will have collided with another atom, when its energy will be converted into kinetic energy. By such a collision, an atom of hydrogen or of helium could acquire a speed greater than the velocity of escape from the earth, but an atom of nitrogen or oxygen would not by this process acquire sufficient speed to escape. The loss of hydrogen and helium from

* From the Norman Lockyer Lecture delivered under the auspices of the British Association on December 6.

the atmosphere of the earth is thus made possible by the fact that free oxygen is present in the atmosphere.

It appears probable that the primitive earth must have remained hot sufficiently long for most of its initial atmosphere to have been lost. It was pointed out by Russell and Menzel that in the stars and the nebulæ neon is as abundant as argon, whereas in the earth's atmosphere argon is five hundred times more abundant than neon. Nitrogen is far less abundant on the earth than in the stars. These large differences in relative terrestrial and solar abundance can be accounted for on the supposition that the rate of loss of atmosphere was very rapid when the earth was hot. When the cooling had proceeded sufficiently far for the escape of the atmosphere to cease, neon had been depleted to a much greater extent than the heavier argon. If this supposition is correct, much of the original oxygen, nitrogen and water vapour and all the original helium and free hydrogen must have been lost. As the molten earth cooled, great quantities of water vapour, carbon dioxide and other gases would have been evolved from the solidifying magma; these, with the residual gases from the initial atmosphere, formed the new atmosphere which, as the earth was then relatively cool, could not escape.

The presence of free oxygen in the atmosphere of the earth needs explanation, for processes are in continual operation that are depleting the store. One of the principal causes of depletion is the weathering of the igneous rocks to form sedimentary deposits which is occurring. In this process much of the ferrous oxide is oxidized to ferric oxide. It has been estimated that during geological times the amount of oxygen thus depleted from the atmosphere is about twice the quantity now present. It is clear that the oxygen must be replenished in some way, and this is done by green vegetation on the earth's surface.

VENUS

The atmosphere of Venus is in marked contrast to that of the earth. The velocity of escape from Venus is 10·2 km./sec. It may therefore be expected that Venus will have an atmosphere comparable with that of the earth in extent and density. The presence of an extensive atmosphere is confirmed by observation. Photographs in ultra-violet light record cloudy markings which rapidly change their form and are of short duration.

To determine the composition of the atmosphere of Venus, or of any other planet, recourse must be had to the spectroscope. Absorption in the atmosphere of the earth is a complicating and troublesome factor. These absorptions can be identified in two ways. First, by observing the spectrum of the sun at different altitudes; the terrestrial absorptions become stronger the lower the altitude. Secondly, if the spectra of light from the east and west limbs of the sun are compared, the absorptions of solar origin show a slight relative displacement caused by the solar rotation, whilst the absorptions of terrestrial origin are undisplaced. The absorptions of terrestrial origin having been identified, the absorptions produced in the atmosphere of a planet can be investigated by photographing the spectra of the planet and the moon on the same night and at the same altitude. Any absorption present in the spectrum of the planet and not in that of the moon, or much stronger in the spectrum of the planet than in that of the moon, must originate in the atmosphere of the planet. Another, and more delicate, method of investigation is to photograph the spectrum of the planet at a time when it is approaching or receding from the earth most rapidly. The absorptions due to the planet's atmosphere are displaced with respect to those due to our own atmosphere.

Complete information about the constitution of any planetary atmosphere is not obtainable, however, because many possible constituents of the atmosphere show no absorptions in the region accessible to study. Amongst such undetectable constituents are hydrogen, nitrogen, helium, neon and argon.

The investigation of the atmosphere of Venus has given no certain evidence of the presence of oxygen. Observations have led to the conclusion that the amount of oxygen must be less than one thousandth part of that above an equal area of the earth. More surprising, perhaps, than the failure to detect oxygen, is the failure to detect the presence of water vapour, even though the tests for water vapour are less sensitive than those for oxygen.

The most interesting fact about the atmosphere of Venus is the great abundance of carbon dioxide. In 1932, Adams and Dunham discovered three well-defined bands in the infra-red region of the spectrum of Venus. These bands had not at that time been observed in any terrestrial spectrum. Theoretical investigations indicated that they might be due to carbon dioxide; this was first confirmed by Dunham. Later, Adel and Slipher reproduced the three bands by passing light through 45 metres of carbon dioxide at a pressure of 47 atmospheres; the absorptions so obtained were less intense than the corresponding absorptions in the spectrum of Venus. They concluded that the amount of carbon dioxide above the surface of

Venus is equivalent to a layer two miles in thickness at standard atmospheric pressure and temperature. For comparison, it may be mentioned that the amount of carbon dioxide present in the earth's atmosphere is equivalent to a thickness of only about 30 feet.

The carbon dioxide will have a powerful blanketing effect, and it is not improbable that the temperature at the surface of Venus may be as high as, or higher than, that of boiling water. The high temperature, the lack of oxygen and the abundance of carbon dioxide can be interpreted as indications that there cannot be any great amount of vegetation on Venus.

MARS

Mars occupies a position between Mercury on one hand and Venus and the earth on the other, as regards size, mass and velocity of escape. The velocity of escape is 5·0 km./sec. It may be expected that Mars will have a much thinner atmosphere than Venus or the earth. The presence of an atmosphere on Mars can be proved by photographing the planet in light of different colours. Photographs in the infra-red show permanent markings, which are evidently surface features, whereas photographs in the ultra-violet show none of these. The atmosphere is extensive enough to scatter ultra-violet light to such an extent that the light cannot penetrate to the surface and out again. The difference in size of the images in ultra-violet and infra-red light indicates that the atmosphere extends to a height of fully fifty miles above the surface.

The polar caps provide additional evidence of an atmosphere on Mars. They wax and wane with the changing of the seasons The changes are to be explained by the melting or deposition of ice, snow or hoar-frost, and, from the rate at which the caps decrease as summer advances, it can be calculated that they are not more than a few inches thick.

All attempts to detect oxygen in the atmosphere of Mars have been unsuccessful. The amount of oxygen is certainly not more than one thousandth part of the amount in the earth's atmosphere. The red colour of Mars, which is unique among the heavenly bodies, provides indirect evidence of oxygen, suggesting rocks that have been completely oxidized. The amount of water vapour in the atmosphere of Mars is so small that it can be detected only under the most favourable conditions. At the Lowell Observatory, which is at an altitude of 7,250 feet, Slipher, in 1908, by comparing the spectra of Mars and the moon when at the same altitude under conditions of exceptional atmospheric dryness, found that the water vapour absorptions were slightly stronger in the spectrum of Mars than in that of the moon.

Carbon dioxide has not been detected in the Martian atmosphere. There is some evidence of the existence of vegetation on Mars. Seasonal changes in form and coloration of the dark areas seem to be reasonably well established, and the interpretation of these changes as due to the seasonal growth of vegetation is plausible. The presence of some carbon dioxide in the atmosphere may therefore be inferred. Mars appears to be a world in the state that the earth will ultimately reach when the oxygen in the atmosphere will have been almost entirely exhausted by the progressive weathering and oxidation of the rocks.

THE MAJOR PLANETS

The major planets, Jupiter, Saturn, Uranus and Neptune, may be considered together. They are large massive planets, of low mean density, the visible disks of which are considerably oblate. Saturn has the lowest mean density of any of the planets, only seven tenths that of water. The velocities of escape from all the major planets are so high that extensive atmospheres are to be expected, containing an abundance of hydrogen and helium.

The telescopic appearance of Jupiter and Saturn confirms the existence of dense atmospheres. Markings in the form of belts parallel to the equator may be seen; these are of complex structure and their details are continually changing. Photographs in the infra-red show many differences from those in the ultra-violet, but again the recorded features are continually changing, so that the infra-red light does not penetrate to the surface.

Some theoretical results of interest have been deduced from the oblateness and mean density of these planets. Jeffreys has concluded that they consist of a core of rock, generally similar to the inner planets in its constitution and of about the same mean density, surrounded by ice-coatings of great depth, above which are very extensive atmospheres. According to the calculations by Wildt, the rocky core of Jupiter has a radius of about 22,000 miles: the ice-coating is 16,000 miles in thickness and the depth of the atmosphere is about 6,000 miles. The rocky core of Saturn is about 14,000 miles in radius; it is covered with a layer of ice some 6,000 miles thick, over which is an atmosphere extending to a height of 16,000 miles. Saturn has the most extensive atmosphere of any of the planets, which explains why it has the lowest mean density and

the most flattened disk. The pressures of these extensive atmospheres are very great; at the bottom of Jupiter's atmosphere, for example, the pressure is fully a million times the pressure at the bottom of the earth's atmosphere. At a relatively small depth in the atmosphere, the pressure is great enough to compress the gas to a density nearly equal to that of the corresponding liquid.

The densities of the atmospheres are low; according to Wildt's calculations, they are 0·78 for Jupiter and 0·41 for Saturn. This enables most of the possible constituents to be excluded, for all known gases, in the liquid or solid state, have densities exceeding 0·3, with the exceptions of hydrogen and helium, and the only other gases whose densities in the liquid or solid state are less than the density of the greater portion of the atmosphere of Jupiter are methane and ethane. It is concluded that the atmospheres of the major planets must contain large quantities of free hydrogen and helium. The planets are believed to have been formed from the sun, which is known to contain a large amount of hydrogen, to the extent of about one third part by weight. As massive planets, like the four major planets, would retain their light constituents, it is to be expected that hydrogen and helium would be present in large amount in their atmospheres.

PLANETARY SPECTRA

The spectra of the major planets are of great interest. Huggins discovered visually absorption bands in the orange and green in the spectrum of Jupiter. These bands appear more strongly in the spectrum of Saturn, but are not found in the spectrum of the rings—a conclusive proof that they originate in the atmosphere of Saturn. Uranus and Neptune show for the most part the same bands with still greater intensity, together with some additional ones. In recent years, the spectra have been extended far into the infra-red by Slipher, and several intense bands have been found in that region.

The origin of these bands remained unknown until a few years ago. Then Wildt succeeded in proving theoretically that certain of the bands agreed in position with bands of ammonia and that others agreed with bands of methane. These conclusions were confirmed by Dunham who, using much higher dispersion, was able to obtain a more complete resolution of the bands into their component lines and found a complete coincidence. He estimated that the quantity of ammonia gas producing the absorptions in the spectrum of Jupiter is equivalent to a layer 30 feet thick under standard conditions. The amount is less in Saturn. The ammonia absorptions are not detected in the spectra of Uranus and Neptune.

Methane is present in much larger amount. Adel and Slipher found that a 45-metre path of methane, at a pressure of 40 atmospheres, gave bands intermediate in intensity between those of Jupiter and Saturn. The much greater strength of the methane absorptions in Uranus and Neptune is probably accounted for by the lower temperatures of these planets. The ammonia must be frozen out of their atmospheres, making it possible to see through them to a greater depth. Adel and Slipher estimated that 25 miles of methane at atmospheric pressure would be required to give absorptions as strong as those of Neptune. The higher gaseous hydrocarbons have been looked for in vain in the spectra of the outer planets. All the absorption bands appear to be accounted for by ammonia and methane. It is a grand slam.

The presence of ammonia and methane in the atmospheres of the large planets is not surprising. They are to be expected as a consequence of the reaction of hydrogen with nitrogen and carbon dioxide on a cooling planet. Such reactions resulted in an atmosphere of hydrogen, helium, and other inert gases, mixed with methane, ammonia and water vapour, but with little or no carbon dioxide or free nitrogen. Below this there would be a deep ocean, strongly alkaline from the ammonia in solution. As the temperature fell still further, the ocean would freeze. It may be mentioned that an ocean consisting of one part of ammonia to two parts of water would freeze at −100° C.; all the four major planets are colder than this.

The ammonia in the atmospheres of Jupiter and Saturn must be nearly on the point of condensation, and the clouds over these planets may consist of droplets of liquid ammonia or even small crystals of frozen ammonia. The mean temperatures of Uranus and Neptune due to solar radiation alone are about −200° C. and −220° C. respectively. At the temperature of Neptune, the methane must be nearly ready to condense.

The nature of the planetary atmospheres, about which so little was known until recently, seems now to have been solved in its broad outlines. As a brief summary we find that we can divide the planets and their satellites into three groups: the small ones, entirely devoid of atmospheres; the middle-sized ones with atmospheres of moderate extent, devoid of hydrogen or compounds of hydrogen with nitrogen or carbon but containing oxygen or compounds of oxygen; and the large ones, with very extensive atmospheres, devoid of oxygen or compounds of oxygen but containing hydrogen and compounds of hydrogen.

Facts and Theories in Protein Chemistry*

IN the last decade, many investigations of an exact nature have been made on the proteins in solution and in the solid phase. Unfortunately, by a dissipation of the available research energy among a wide variety of proteins and by a signal absence of co-operation among the researchers themselves, less significant advances have been made in the elucidation of fundamental principles than would otherwise have been the case. It was a happy inspiration, therefore, which brought together most of the authorities on protein chemistry in Europe at the Royal Society on November 17 to compare their experiences and discuss each other's difficulties.

Prof. The Svedberg (Uppsala) opened the conference with a vigorous and notably wide survey of recent developments in the physical chemistry of the proteins. According to precise physical measurements, protein particles have such characteristic and reproducible properties that it is no longer possible to deny them the right of classification as giant molecules. Sedimentation studies on native soluble proteins reveal a striking homogeneity in the sizes of individual molecules, and the method of electrophoresis reveals a similar homogeneity in their free charges. Measurements of protein molecular weights by sedimentation equilibrium or by a combination of sedimentation velocity and diffusion give values which, rather unexpectedly, conform to a law of simple multiples.

Assuming 17,600 as the unit of molecular weight, the values of some sixty native proteins so far investigated, including the giant hæmocyanin molecules with weights of several millions, may be expressed as multiples of this unit by factors containing powers of 2 and 3. The rule is approximate only, suggesting the existence of some underlying architectural principle in the arrangement of the amino-acid residues. Differences in the percentage amino-acid composition of proteins may explain the spread of molecular weights above and below the simple multiple value. Determinations of osmotic pressure give values which agree well with molecular weights obtained by sedimentation methods. X-ray investigations of pepsin, insulin, lactoglobulin and hæmoglobin in the crystalline state have given values of 40,000, 37,200, 36,500 and 69,000 respectively, while the ultracentrifuge gives 37,000, 38,000, 39,000 and 68,000.

Viscosity measurements on anisotropic proteins may be correlated with the axial ratios of the corresponding molecular ellipsoids of rotation by means of equations proposed independently by Kuhn, Burgers and Polson. From the axial ratio the molecular frictional coefficient may be calculated, and this in turn supplies the necessary information for calculating molecular weights from diffusion data. Molecular weights thus obtained from viscosity and diffusion data agree with the ultracentrifuge values only when Polson's equation, which has a purely empirical basis, is used. Studies on the peptic digestion of egg albumin by Tiselius show that the decomposition products have a much lower electrophoretic mobility than the uncharged protein. This supports the view that the constituent units of a protein particle are bound together by specific chemical linkages and that the particle is in fact a single molecule.

Recent theories of protein structure proposed by Wrinch and by Bergmann and Niemann imply the chemical individuality of the protein molecule. These theories are important as a stimulus to further research; but caution must be observed in their acceptance. In the case of Bergmann and Niemann's theory, which assumes a fundamental regularity in the arrangement of the amino-acid residues in the molecule, certain difficulties exist. For example, the theory gives a molecular weight of 69,000 for hæmoglobin based on a cysteine content of 0·5 per cent and assuming three cysteine residues per molecule. Ultracentrifugal and X-ray methods show, however, that hæmoglobin may be split reversibly into halves of approximately equal size.

Dr. Linderstrøm-Lang (Copenhagen) emphasized the value of enzymic degradation as a method of studying the structure of the protein molecule, especially in recent years with the advent of crystalline and relatively pure enzymes. Considerable care is still required in the interpretation of the results of these studies, since it is now becoming clear that some fundamental change scarcely distinguishable from denaturation is a necessary preliminary to the enzymic disruption of polypeptide bonds in the protein molecule. Dr. D. Wrinch (Oxford) gave a clear presentation with the aid of models of her 'cyclol' hypothesis, which assumes that the protein molecule is constituted of diazine and triazine rings arranged alternately in a kind of fabric which may be folded according to purely geometrical considerations. The space-enclosing fabric with 288 amino-acid residues takes

* Substance of a discussion on "The Protein Molecule" held by the Royal Society on November 17.

the form of a truncated tetrahedron and this represents the globular protein molecule of weight 35,000. Dr. A. Neuberger (London) pointed out that the presence of diazine and triazine rings in proteins is not supported by chemical facts. It has never been shown that a lactam-lactim tautomerism exists in peptides, nor has a polymerization of peptides to cyanidine-like rings been realized. The chemical and enzymic behaviour of proteins is also not in accordance with the cyclol hypothesis. The Bergmann and Niemann hypothesis was also criticized by Dr. Neuberger on the grounds that the limits of error in the present methods of estimating amino-acids are so great as to render the deductions made from them statistically of doubtful value.

Dr. G. S. Adair (Cambridge) showed that for hæmoglobin, egg albumin and serum albumin, the maximum values for the molecular radii calculated from measurements of diffusion made at Uppsala, were not more than 5 per cent greater than the minimum values calculated from measurements of the hydration and density of protein crystals suspended in sodium phosphate buffers. He also discussed the effects which salts have on the iso-electric points of proteins. Dr. K. O. Pederson (Uppsala) described new work on the dissociation of proteins, particularly the type of molecular splitting which one component of a binary mixture induces in the other. The dissociation is more marked when a carbohydrate-rich protein is mixed with a carbohydrate-poor one. It is also marked in serum in which there is evidence that phosphatides take a role similar to the carbohydrate. The X-fraction seen in the sedimentation diagram of normal serum is identical with the intermediate or β-globulin seen in electrophoresis, and this fraction according to Tiselius and Blix is the main carrier of the serum phosphatides. Changes which affect the serum calcium, for example, dialysis, addition of salts, etc., affect the sedimentation rate of the X-component. The effect is probably on the phosphatide linkage.

Dr. Pederson suggested that these and other dissociation effects are best explained by postulating that the larger protein molecules consist of small primary protein units linked into a secondary structure by means of carbohydrate, phosphatide, nucleic acid, etc. This view received striking support from Mr. J. St. L. Philpot (Oxford), who described how the sedimentation constant of casein can be altered at will to any value between 6 and 10·4 by the addition of calcium. This appears to be a case of primary protein units linked by a polyvalent inorganic ion. A surprising fact, however, is that only one boundary—an apparently homogeneous one—is present. It is possible that the primary protein units are very small, but if in fact they are about 100,000 in weight ($S_{w,20°}=6$) the absence of two boundaries might be explained by postulating an extremely mobile form of calcium-casein equilibrium.

Prof. H. H. Weber (Münster) opened the afternoon session with a paper on the proteins of muscle, dealing particularly with myosin. Solutions of this protein show a high and anomalous viscosity and marked anisotropy of flow. Solutions more concentrated than 2 per cent cannot be obtained in the disorientated state, but orientated threads may be spun like artificial silk to much higher concentrations. These threads resemble muscle fibres closely in swelling power, tensile strength, elastic properties and X-ray appearances. Measurements of the double refraction and the *eigendoppelbrechung* of the stretched myosin thread show that these correspond quantitatively with the values for the *Q*-disks of muscle. The *Q*-disk consists therefore of fully orientated myosin rods. Complete elastic stretching of the myosin filament results from stretching of the rods themselves, the process consisting evidently in a straightening of folded filamentous molecules. Myosin may be denatured by heating above 40° C., the threads undergoing an irreversible decrease in double refraction and a marked contraction. The view is put forward that muscle contraction consists in a chemically induced denaturation of myosin molecules which is reversible in the circumstances pertaining to muscle. Dr. G. Boehm (Basle) showed a number of X-ray diagrams of stretched myosin threads. Prof. K. H. Meyer (Geneva) developed some interesting ideas on mechanically induced molecular transformations, citing the solubility and elastic changes caused in the crude material from the silk gland by simple stretching, and the crystallization of metastable selenium by similar treatment. He is of the opinion that blood plasma may be regarded as a supersaturated fibrinogen solution and that mechanical denaturation may suffice to explain the phenomena of blood clotting. Dr. W. T. Astbury (Leeds) referred to the elegant method of progressive piling of protein monolayers on a metal slide until it is possible to measure the thickness of a monolayer by means of a screw micrometer.

Dr. Evert Gorter (Leyden) discussed the behaviour of those proteins which spread easily on water surfaces and others, for example, fibrinogen and myosin, which only do so after treatment with traces of proteolytic enzymes. Spreading experiments only give information about one side of the film—fortunately the more important polar side in contact with the water. The view that spread proteins are denatured is not in agreement with all the facts. Denatured egg albumin does not spread, and pepsin and trypsin remain active as

proteolytic enzymes after spreading. Spreading does not necessarily cause denaturation because the polar groups remain active and free. Denaturation by shaking, on the other hand, results from juxtaposition of polar surfaces in the foam so that only non-polar groups are exposed and the foam becomes insoluble. It is unlikely also that spread proteins are denatured since these are employed widely in the architecture of living tissues. Dr. J. F. Danielli (London) pointed out that, from a consideration of surface forces, it appears that the attraction between hydrocarbon residues of the amino-acids are sufficient to maintain a folded globular form in the native protein. These forces are insufficient, however, to maintain a specific rigid structure, and additional chemical bonds must be postulated for this purpose.

Miss D. Crowfoot (Oxford) followed by Prof. J. D. Bernal (London) discussed the technical difficulties in protein crystallography, especially those arising from the weakness of the reflections and from hydration of the crystals. Both speakers referred to the inadequacy of the X-ray data available on the proteins and to the necessity for caution in the interpretation of the results. Of the seven proteins so far examined, dried insulin is the simplest, having a rhombohedral cell containing only one Svedberg unit of 35,000. One cannot be certain even in the case of insulin whether the crystallographic unit is a true unit or itself consists of sub-units. Prof. J. R. Marrack (London) discussed experiments with conjugated antibodies which lead to the conclusion that the antibody-antigen reaction is not due to simple combination of polar groups, but probably involves specific amino-acid configurations. Dr. E. R. Holiday (London) supported this view on the basis of immunity phenomena exhibited by serum albumin after incomplete digestion with pepsin.

A. S. M^cFARLANE.

Sir Charles Parsons and Marine Propulsion

ON December 2, at the Institution of Mechanical Engineers, before an audience which included many engineers who have been closely associated with the application of the Parsons steam turbine to ships, Mr. S. S. Cook delivered the third Parsons Memorial Lecture, taking as his subject "Sir Charles Parsons and Marine Propulsion". Born in 1875, and like Parsons a Cambridge wrangler, Mr. Cook has been connected for a long period with the Parsons Marine Steam Turbine Company and is well known in engineering circles for his original investigations and his memoirs on the marine steam turbine.

The story which Mr. Cook unfolded may perhaps be regarded by some as a thrice-told tale, for Sir Charles Parsons, either himself or in collaboration with others, placed on record in papers to technical institutions the various steps in the progress of the turbine as applied to steamships, but there are features in the story which when told by others only heighten our respect and admiration for Parsons when he was faced with difficulties which would have overwhelmed men of less determination. None of those who were present at the Diamond Jubilee Review of 1897 and saw the little *Turbinia* steam at more than 30 knots up and down the lines could have known that three years previously the same craft with her original machinery, to the intense disappointment of Parsons and his colleagues, had failed to obtain a speed of even 20 knots. "The spectators", said Mr. Cook, "may have been thrilled to see a tiny vessel racing down the lines at such unusual speed, but their feelings could have been nothing compared with those of the few on board the vessel, who had emerged so triumphantly from depressing failure into glorious success".

The Parsons turbine, it will be remembered, was invented in 1884. For the next ten years or so it was used exclusively for driving electric generators, and it was not until the compound condensing turbine had shown its superiority over the best reciprocating engine that any steps were taken to apply it to ships. The speed at which it revolved seemed to some to rule it out for this purpose. In January 1894, however, after some preliminary work, Parsons took out Patent 394 for "Propelling a steam vessel by means of a steam turbine, which turbine actuates the propeller or paddle shaft directly or through gearing", and the pioneer company, the Marine Steam Turbine Company, was formed. The directors of the company were the Earl of Rosse, Parsons, N. G. Clayton, C. J. Leyland, J. B. Simpson and A. A. Campbell Swinton. After some experiments with models, the *Turbinia* was built. She was 100 ft. long and 44 tons displacement. Into her Parsons fitted a single water-tube boiler and a single radial flow turbine. Designed to develop 1650 h.p., the speed of the turbine was 1600–1700

r.p.m. A single propeller of 20 in. diameter was used. The results being unsatisfactory, thirty-one different trials were made with different propellers, but the best speed fell short of 20 knots. "At this stage," said Mr. Cook, "we cannot fail to admire the indomitable courage of Parsons. One may hazard the opinion that with most engineers the experiments would have ended there. The gap between the estimated speed of 30 knots and the 20 knots actually obtained was an enormous one. The power varying as the cube of the speed, such a difference indicates a shortage of propulsive power in the ratio of 8 to 27. Faced with a failure of this magnitude, most men would have cut their losses, and in that case there might never have been a *Mauretania* or a *Lusitania*, no *Dreadnought* or super-dreadnoughts, no *Queen Mary*—who knows?"

To locate the failure, Parsons fitted a torsionmeter on the shaft, probably the first marine torsionmeter of any type. The greater part of the loss was found to be due to 'cavitation', a phenomena which had been observed by Sir J. I. Thornycroft and S. W. Barnaby during the trials of the 27-knot destroyer *Daring*. They had found that if the mean pressure of propulsion over the blade area exceeded 11¾ lb., cavitation occurred. In the *Turbinia* the pressure had been some 60 lb. With this knowledge, and backed, as he always was, by his colleagues, the *Turbinia* was fitted with new machinery, consisting of three turbines in series driving three propeller shafts having altogether nine propellers. Ready again for trial in February 1896, a speed of 32¾ knots was obtained and after other modifications, 34 knots, or four knots more than the fastest torpedo craft afloat.

Mr. Cook did not say how much all this pioneering work had cost; far more, it may be presumed, than the capital of £24,000 with which the company was formed. Sixty years before, the Ship Propeller Company had sustained a loss of £50,000 over the historic screw-driven *Archimedes*, a vessel of only a few hundred horse-power. The demonstration at Spithead had, however, shown the possibilities of the new means of propulsion, and a new company, the Parsons Marine Steam Company, having been formed with a nominal capital of £500,000, an order was obtained from the Admiralty for the destroyer *Viper*, and at the same time Sir W. G. Armstrong, Whitworth & Co. ordered turbine machinery for a destroyer afterwards named the *Cobra*. Both of these vessels were unfortunately wrecked in 1901. These disasters might well have seriously affected the fortunes of both inventor and his company had they not already secured the co-operation of the Dennys of Dumbarton and Captain John Williamson, in the building of the Clyde river steamer *King Edward*, the pioneer of turbine-driven mercantile vessels. The success of the *King Edward* had far-reaching results. She was soon followed by the cross-Channel steamers *Queen*, *Brighton*, *Princess Maud* and *Londonderry*, and the Dumbarton built vessels *Lhasa*, *Linga*, *Lama* and *Lunka* for the British India Steam Navigation Company. The marine steam turbine was now successfully launched on its astonishing career, and the end of its first decade was marked by the construction of the *Lusitania*, *Mauretania* and H.M.S. *Dreadnought*.

"With the completion of these notable vessels," said Mr. Cook, "it might be thought that Parsons had reached his goal. . . . But Parsons was far from satisfied." The application of the steam turbine so far was limited to fast vessels of large power. Could it be used for vessels of moderate speed? First of all, Parsons introduced the combined system in which the steam exhausting from a reciprocating engine was utilized in a low-pressure turbine. The pioneer vessel with this arrangement was the *Otaki*, also built at Dumbarton. Then he turned to the use of toothed-wheel reduction gearing. He had fitted such gearing in a 10 horse-power launch in 1897, but experiments were necessary before using gearing for larger vessels. So the *Vespasian* was purchased, her triple expansion enginess were replaced by single-reduction geared turbines, and she was set to work in the North Sea. Her success ushered in yet another revolution in marine propulsion. To-day, single reduction geared turbines are found in the majority of warships and in such vessels as the *Queen Mary* and the new *Mauretania*.

But the full tale of Parsons' pioneering work in connexion with marine propulsion does not end with the direct-driving turbine, the exhaust turbine or the geared turbine. He was the first to make a vacuum tank for the study of model screws, he invented the vacuum augmentor, he introduced the creeping mechanism for gear-cutting machines, he made exhaustive experiments on the erosion of propellers, and he was the first to appreciate the value of the Michell thrust-block. Then, too, he was ever an advocate of the use of steam at high pressures and high temperatures, and in the Clyde steamer *King George V* fitted turbines working with steam at 550 lb. pressure and 750° F. temperature. The world, said Mr. Cook, is the debtor to Parsons for his faith in the turbine, his courage and perseverance, and also for the wise provisions he made for the dissemination of his knowledge and experience. Parsons has won titles to fame in many spheres of applied science, but in none of brighter lustre than in the field of marine propulsion.

Obituary Notices

Prof. E. M. East

PROF. EDWARD MURRAY EAST, whose death has recently been reported, belonged to the group of Mendelian pioneers who began their investigations in the first decade of the present century. His most important contributions to plant genetics were in connexion with the breeding of potatoes, maize and tobacco. Not only was some of his work of great practical value, but he also made fundamental contributions to various aspects of plant breeding, especially to inbreeding and hybrid vigour, selection and the explanation of the phenomena of self-sterility in plants. He was one of the leading American plant geneticists of his time.

Dr. East was born at Du Quorn, Illinois, on October 4, 1879, and graduated at the University of Illinois in 1900. He became assistant chemist and then assistant in plant breeding at the Agricultural Experiment Station of the University of Illinois, and in 1907 received the Ph.D. degree for a thesis entitled "A Study of the Factors Influencing the Improvement of the Potato". This, like much of his later work, was characterized by quantitative as well as qualitative treatment of his material, at a time when nearly all the early Mendelian work was mainly qualitative and descriptive in character.

East was shortly appointed agronomist at the Agricultural Experiment Station, Storrs, Connecticut, whence in 1909 he went to Harvard as assistant professor of experimental plant morphology at the Bussey Institution. Since 1926, he has been professor of genetics in Harvard University. East's work on inbreeding, begun at Storrs, culminated in a book, "Inbreeding and Outbreeding", published in collaboration with D. F. Jones in 1919. His investigations of maize were especially valuable as indicating at an early period that quantitative characters such as length of cob are inherited and segregated according to the Mendelian rules. Part of this work was done in collaboration with Dr. H. K. Hayes. The inheritance of flower size in interspecific crosses of *Nicotiana* was one of the earliest studies of its kind.

Probably East's most important contribution to plant genetics was his masterly analysis of self-sterility in tobacco, in a series of papers beginning about 1915. He first crossed *Nicotiana alata* with *N. sanderæ*, and by analysis of the offspring and the crosses which could be made between them, he discovered that they fell into three groups of plants, each heterozygous for two different sterility factors or *S*-genes. These he called S_1S_3, S_2S_3, and S_1S_2. A plant which was S_1S_2, for example, could only be successfully pollinated by pollen carrying the S_3 factor. The other types of pollen tube grow so slowly in the style that the flower drops off before the pollen tubes reach the ovary. But he showed that by opening the buds, and so giving the pollen tubes a longer interval for growth, self-fertilization could take place, producing plants homozygous for particular *S*-factors. The number of such *S*-factors in *Nicotiana* was finally increased to fifteen, all allelomorphic, that is, representing different changes in one locus of a chromosome. Similar conditions have since been found in various other plants, such as red clover and *Brassica*.

East was always interested in the general biological principles related to genetics, and in his later years was particularly concerned with questions of human population and related problems. "Mankind at the Crossroads" (1923), which was widely read, was a valuable study of population problems and the world's food supplies, although the emphasis on over-population has been partially negatived by the continued fall in birth-rates. A volume entitled "Biology in Human Affairs", was edited in 1927.

During the period 1908–18, East was a collaborator in the tobacco breeding investigations of the United States Department of Agriculture, and during the Great War he was chairman of the Botanical Raw Products Commission. R. RUGGLES GATES.

Prof. A. K. Mordvilko

ALEXANDR KONSTANTINOVICH MORDVILKO, an aphidologist and parasitologist of world repute, who died on July 12, was born in 1867 in the village of Stolovichi, Minsk province of Russia. As a son of a minor cleric, he received his general education in the Minsk seminary, but then entered the University of Warsaw and after taking his degree in natural sciences in 1893, obtained a post-graduate scholarship which enabled him to study, first at Warsaw, then at the zoological stations of Naples, Marseilles and Villefranche. Two years as lecturer (on animal parasitology) at the University of Kiev were followed by an appointment to that of St. Petersburg, then of Moscow. In 1911 he joined the staff of the Zoological Museum of the Russian Academy of Sciences, where he spent the rest of his life, while giving lectures at the University and the Agronomical Institute.

As the theme of his first scientific work written at the end of his university studies, Mordvilko took the investigation of the Aphididæ (plant-lice) of the Vistula region, including their bionomics and anatomy. This group of insects is remarkable for exhibiting a wide range of biological phenomena of great general significance, such as polymorphism, change of hosts, variations in the life-cycle and types of reproduction, etc. Their study became his life work.

The execution of this work by Mordvilko is an outstanding example of results that can be achieved by a thorough and many-sided study of a single group of organisms. His morphological work is remarkable for its accuracy and abundance of exactly observed details, while the biological significance of various structures was kept in view. His systematic

work, which resulted in a mass of most carefully described new genera and species and in revisions of whole difficult groups of aphids, can be taken as a standard for any taxonomist. His main interest was, however, the intensive study of the bionomics of aphids, most particularly with regard to the evolution of the life-cycle and the change of hosts. Exhaustive studies of many groups of aphids with alternate hosts led Mordvilko to the elaboration of a remarkably well-documented theory of the origin and evolution of the habit of changing hosts in Aphididæ, which he has later extended to the explanation of a closely parallel phenomenon in the fungi causing rust (Uredinales). Connected with these specialized series of investigations were the more theoretical works of Mordvilko on parasitism in general, as well as on the problem of evolution and species formation.

As a man, Mordvilko was almost unbelievably modest and unassuming, and, on the first encounter with him, created a wholly false impression of a bashful and probably narrow-minded person, interested in nothing but his plant-lice. On a closer acquaintance, he appeared as an exceptionally widely educated man, with far-reaching and original ideas on many aspects of biology. The outstanding features of his character were deeply felt kindness and sincere friendliness to everybody, outwardly expressed in a most charming, quiet, endearing smile. All his acquaintances were regarded by him as friends and became so, and he was incapable of making any enemies.

It can be truly said that A. K. Mordvilko's death closes a long and most fruitful chapter in the study of the Aphididæ, to the knowledge of which he has contributed more than anybody else.

B. P. UVAROV.

DR. UVAROV has outlined Prof. Mordvilko's contribution to science and it remains to me to add my personal tribute to the memory of one who over a long number of years and often at great difficulty to himself, proved such a valued correspondent. His vast knowledge was ever at our service; he put himself to endless trouble to satisfy our needs for study-material; his books and papers were generously presented. He was a man of infinite pains and the embodiment of the patient investigator, taking sometimes twenty years to elucidate a single point. For forty-three years, Mordvilko was carrying on his aphidological and other studies, and during the last twenty broadened his basis so much that for years to come the suggestions contained in his works will give rise to new lines of research, and though some of his theories may have to be modified, he will remain an outstanding builder.

F. LAING.

WE regret to announce the following deaths:

Sir Thomas Callendar, deputy chairman and managing director of Callendar's Cable and Construction Co., Ltd., a pioneer in electricity supply, on December 2, aged eighty-three years.

Mr. W. P. Dreaper, O.B.E., formerly superintendent of H.M. Factories at Sutton Oak and Ellesmere Port, lately editor of the *Chemical World*, on December 2, aged seventy years.

News and Views

Publication of Scientific Research

A LARGE part of Sir William Bragg's presidential address to the Royal Society, delivered on November 30, was concerned with scientific publications, and he referred particularly to the duty of the Society in connexion with the encouragement of research to secure the preparation and presentment of its results, so that they can be sufficiently appreciated and incorporated with understanding into every activity, intellectual or physical, to which they apply. Though he does not think that men of science can claim to be given the direction of affairs in which their discoveries play a great part simply on that account, they are at least bound to see that acquired knowledge is rightly stated so that it can be rightly used, and he regards the vigorous action of the British Association in such matters as a commendable extension of its original purpose. This consideration of opening to mankind the new fields of natural knowledge strengthens the case for reconsidering the arrangement and presentation of research results which arise from the voluminous character of present-day research. Commenting on the small attendances and lack of good discussion when papers are presented before a scientific society, Sir William Bragg referred to greater stress which has recently been made on the provision of opportunities for organized discussions in which some important subject of recent development was considered by the workers in that field. Very satisfactory attendances have been obtained at such meetings.

SIR WILLIAM BRAGG considers that the recent plan of publishing summaries of papers as an appendix to the *Proceedings* as soon as the papers are received, while publication of the papers themselves is deferred in the usual way, not merely secures an earlier announcement of the discovery, but also the collection of summaries presents the general trend of research to those who are not specialists. With regard to summaries, he pointed out that the ideal is more than a mere digest or shortened form of the paper, and should be different from the paper itself, in that it is addressed to a wider circle of readers, which may include the experts, but includes also many others, who should, in fact, receive the principal attention.

Accordingly, he stressed the importance of insisting that the general account given in this way should be intelligible to a sufficient number of persons. Sir William also queried whether it is necessary that the *Transactions* and *Proceedings of the Royal Society* should contain as much as they do at present. When a new departure in experiment or theory is made and a new fact discovered or a new co-relation, it is right that a careful and complete explanation should be given, and if it is not too long, it is excellent that it should appear in the *Proceedings*. If, however, the novelty leads, as it often does, to a steady output of observation, extension, confirmation and illustration, many figures and bulky tables, complete publication to the world might become unnecessary. The scientific world requires a general account of progress made, so that its bearing may be clear. The *Proceedings* should accordingly contain papers of original discovery or fresh departure, but as regards continuation papers, as they may be called, properly written summaries should be enough.

Co-operation in Research

INTERNATIONAL co-operation in scientific research was also discussed in appreciative terms by Sir William Bragg, and he referred to a letter received from Dr. Bosch, president of the Kaiser Wilhelm Gesellschaft, inviting the co-operation of the Royal Society in some scientific enterprise which would advance science and at the same time promote understanding and good will, in which an exchange of visits between representatives of the Kaiser Wilhelm Gesellschaft and the Royal Society was suggested.

National Registration for Man-Power

IN the House of Commons, on December 1, Sir John Anderson, Lord Privy Seal, outlined the Government's scheme for organizing the national resources in the service of the State. The plan involves: an immediate voluntary register of man- and woman-power throughout the kingdom; the publication of a handbook written in simple language as a guide to be sent to every household; a co-ordinated campaign of recruiting for the Services; further development of training facilities for new volunteers; making preparations for compiling in the minimum length of time a universal register under compulsory powers in the event of war. The scheme received general approval from the House. Though the time is not propitious for considering the scheme from the particular point of view of the scientific worker (further details must be known before this can be done), it is gratifying to think that embodied in the scheme is the possibility of the man of science being given the opportunity to give the State of his best (see NATURE of October 15), that is, not as a "military subordinate", but in a position where he has "a chance to use his imagination and knowledge co-ordinated with that of his fellow scientific workers and technicians, to criticize and direct, in so far as he is competent, the character of operations". Thus, and only thus, can science be expected to contribute its full share to Sir John's scheme for ensuring that our man-power and woman-power are organized in the most effective and practical way for the voluntary service of the State.

A FULL list is also to be prepared of all the key occupations which would become so essential to the nation in mobilizing for defence. In addition, special arrangements are being made for the compilation of separate registers of persons possessing exceptional professional or technical qualifications. Many of the scientific and technical institutions, we understand, have already taken steps to compile such registers, and these will be available to the Government when required. These registers, together with the records already available of men included in the special list of vital occupations, will constitute the National Voluntary Register. In the last War, many specially qualified men, including men of science, were engaged in the Services at posts which could have been just as ably, if not even more ably, filled by men with less specialized training. The National Voluntary Register will go far in preventing such a waste of man-power in the event of another war. The Government's action in building up its scheme on a voluntary basis rather than resorting to compulsion, at any rate during peace time, follows true democratic principles and is therefore commendable. Any doubts over this point of view should be allayed by Sir John's statement that these precautionary steps taken now will make it possible to compile a compulsory register within three weeks if necessary. In the event of war, of course, it would be necessary to survey and marshal our resources as a whole. The voluntary register would not then be enough, and it would become necessary to compile a universal register under compulsion. To be effective, however, such a register must be up to date, and this condition can be satisfied only if it is compiled at the time when the occasion for its use arises.

Indian Cultural Studies

IN the discussion which followed Mr. Barger's lecture at the Royal Society of Arts on November 30 (see p. 1046) interest in the future of the India Museum at South Kensington and the position of Indian studies in Great Britain will appear to have eclipsed the claims to attention of the lecturer's pioneer archæological work in Swat and Afghanistan. The importance of the question raised in his concluding remarks will be accepted in palliation. The anomalies and obstruction to development arising from the lack of cohesion and co-operation among the eight or ten organizations in London associated with Indian studies were characterized with wit and acumen by Mr. F. J. Richards, and echoed by each subsequent speaker in the discussion; while these criticisms were endorsed by Sir Richard Winstedt, who described briefly such steps, inadequate as they admittedly are, as it has been possible to take to meet these deficiencies in some measure by the provision of lectures in Indian art and archæology at the School of Oriental Studies, an institution, which, it is to be noted, already has wide commitments in other directions. On one point, which for some time past has been regarded with dismay among those

interested in Indian cultural studies, Lord Zetland, who was in the chair, was able to reassure his audience. The risk, he said, that the collections of the India Museum might be dispersed, is at an end; and indeed, there is a prospect that the Indian sculptures at the British Museum (Bloomsbury) may be transferred to the India Museum at South Kensington.

THE discussion was an indication, if such were needed, of the existence of a strong body of instructed public opinion, restricted though it may be in extent, that a remedy must be sought for the present highly unsatisfactory position of Indian cultural studies. That there is need for an organized centre devoted to them may be argued on the ground of public policy in view of the future relations of Great Britain and India; but it is also at the moment in pressing need of educational facilities in London. Contrary to the contention frequently advanced, Mr. Richards, from his experience as an honorary lecturer on Indian archæology in the University of London of some years' standing, was able to testify to the demand for instruction in this group of subjects; while the gratitude with which the rearrangement of the Indian collections at South Kensington on cultural lines has been acclaimed is a measure of the general appreciation of the possibilities of further systematic development in teaching and research. Whether provision of an organized centre of teaching and research can most suitably be made in connexion with the India Museum on the lines suggested in relation with the University of London is a matter for further consideration. The position of the Victoria and Albert Museum, of which the India Museum is at present a part, under the Board of Education, is anomalous. It presents difficulties, not insuperable, no doubt, which render comparison with other museums exercising teaching functions beside the mark, even though here, as in other of the national collections in London, the system of guide-lecturers exists for instructional purposes. This system might well be extended to meet needs of more advanced instruction. In any event, no scheme of instruction can attain efficiency without the closest association with the collections and staff of the India Museum; nowhere else in Great Britain is there the systematic knowledge and the carefully graded series of specimens, for example, in pottery or beads, which may not be sufficiently spectacular for exhibition in public galleries, but are of the indispensable groundwork in instruction.

Mr. E. Thurlow Leeds

MR. EDWARD THURLOW LEEDS, keeper of the Ashmolean and the Department of Antiquities in the University of Oxford, whose election to a professorial fellowship at Brasenose College is announced, holds a position of distinction among archæologists for his carefully documented studies in Celtic and Saxon art and archæology. Mr. Leeds was educated at Uppingham and Magdalene College, Cambridge, on which foundation he was a scholar. He joined the staff of the Ashmolean as an assistant in the Department of Antiquities in 1908. Since the Great War, Mr. Leeds's influence on the teaching of archæology at Oxford has been profound; and his appointment as keeper of the Ashmolean on the death of Dr. D. G. Hogarth was regarded as both opportune and a well-merited recognition of his efforts in developing these studies in the University. Mr. Leeds was a vice-president of the Society of Antiquaries of London in 1929–32 and Rhind lecturer in archæology in 1935, his lecture on "Early Saxon Art and Archæology" afterwards appearing in book-form. Mr. Leeds's responsibilities as keeper are now to be enlarged by the addition of an Institute of Egyptological Studies to the Museum. This is in accordance with a decree passed in Congregation of the University on November 29, which gives practical effect to the bequest, accepted in January last, by the late Prof. F. Ll. Griffiths, professor of Egyptology in the University of Oxford, and Mrs. Griffiths for that purpose. Although the Institute will form a department of the Ashmolean, it will be under the control of its own committee of management, a representative body.

The Scientist and the Philosopher

FOR his Friday evening discourse at the Royal Institution on December 2, Viscount Samuel took as his subject, "The Scientist and the Philosopher". He said that in the complicated civilization of the modern world a division of labour is necessary, but this is sometimes carried to excess. The separation between science and philosophy gives an example. This is not, as it might seem, a merely abstract and academic matter, remote from affairs. Action is ruled by ideas. Philosophies of some kind move the nations. Every land resounds with the tramp of armies, and the air throbs with the droning of their aircraft. Behind the armies are the dictators or the parliaments. Behind them are the political creeds, and behind the creeds are the philosophers who inspired them. Our age needs above all else a new synthesis of science and philosophy, together with religion, to supply the ideas that should guide the modern world. There are many things that philosophy should accept from science. Scientific workers in their turn may derive help from philosophy. They might be induced not to attribute physical qualities to human mental concepts, such as space; nor to assume that, because phenomena are out of reach of our means of observation, it follows that Nature does not determine them according to uniform laws. Two fundamental questions remain unsolved, and philosophers await the answers—from physics, the cause of gravitation, and from physiology the nature of thought. It is often said that these can never be solved; but if we view what has been the progress of knowledge between the stone age and now, further advances such as these are not inconceivable; they may indeed be close at hand. There is nowadays a marked convergence of science and philosophy. Let this develop and let religion, guided by reason and conforming to fact, take her place in the great synthesis; then man will feel at one with himself, will confront with new energy the confusions and perils that beset him, and be able to march with confident step into the future.

From Magic to Science

A MEETING of the Society for the Study of Alchemy and Early Chemistry took place on December 7, at Queen Mary College, London, when Mr. J. C. Gregory delivered a lecture entitled "From Magic to Science". Mr. Gregory traced the interplay between reliance on magical efficacies, on one hand, and a recognition of rationally conceived agencies, or natural laws, on the other. Thus alchemy, complicated by mysticism and animism, had its rational theory, as in the Aristotelian Doctrine of the Elements, and its reliance on laboratory procedure. It had also its magically conceived efficacies, such as the reputed powers of the Philosopher's Stone. As the rational recourse constantly invaded magic, so the magical recourse influenced rational procedure. There came a point, however, when the magical belief was discarded to make way for a more scientific concept of natural laws. Mr. Gregory pointed out that the seventeenth-century corpuscle was a great scientific rationalizer of magic. Boyle discreetly reserved, however, some medicinal virtues for gems as a scientifically 'purified magic'. His reduction of the potency in the Powder of Projection, or in the Alkahest, to corpuscular catalysis illustrated the rationalization of magic by science. Though the master Therion still hoped to vindicate the thaumaturgic agent of alchemy, he deferred to present thought by applying the 'method of science' to the 'art of magic'.

International Telephone Conference

A MEETING of the Comité Consultatif International Téléphonique (C.C.I.T.) was opened in London on December 5 by Sir George Lee, engineer-in-chief of the Post Office. The conference is being attended by about a hundred delegates from fourteen different countries and will continue until December 17. Most of the delegates are telephone experts, and they are discussing various technical problems encountered in the operation of international line telephone communication. The work of the Conference is divided between two committees, the first of which is studying the technical problems of long-distance telephone calls, including the suppression of noise and the improvement of quality of reproduction of the human voice. The second committee is studying the special problems encountered in carrier-current telephony, in which a number of conversations are carried simultaneously as a modulation of a high-frequency current on one pair of wires. As an extension of this problem, the question of providing international circuits for television programmes will be considered. The holding of the conference in London is particularly opportune, for during the past fifteen years direct connexions with the majority of the capital cities of Europe over the ordinary land-line network have been established in London, which, with the development of long-distance radio links, has thus become the main world switching centre for inter-continental telephone calls.

Radio Communication for the Colonies

ACCORDING to a statement in *The Times* of November 30, the chairman and managing director of Messrs. Cable and Wireless, Ltd., has made an offer to the Government to create a system of wireless telegraphic and telephonic communication throughout the Colonial Empire without cost to the administrations or the peoples concerned. The scheme provides for the installation of radio equipment at each of the cable stations where no commercial wireless service is already in operation. The Company will bear the cost of installation and any experiments necessary; and while the new facilities will be complementary to the existing cable services, their commercial use will bring additional revenue to the Company. The scheme is of great significance from strategic and economic points of view; the wireless stations will ensure a second line of defence for inter-Colonial communication, and provide the Colonies with a means for their keeping in touch with aircraft and ships in home waters; in addition, Imperial development and unity will be promoted through an extension and cheapening of communications. The establishment of the service would also enable a great deal of valuable technical research to be carried out in connexion with the propagation of waves to various parts of the world. In view of the advantages accruing to the Colonies under the proposals, the offer has been made on the assumption that the Company would be given a non-restrictive licence on broad lines.

Memorials to Inventors

ON November 17 and 24 memorials were unveiled respectively to John Boyd Dunlop (1840–1921) who fifty years ago invented the pneumatic tyre for cycles, and to Joseph Aspdin (1779–1855), the inventor of Portland cement. The memorial to Dunlop is a plaque which has been erected at Fort Dunlop, Birmingham, the great works of the Dunlop Rubber Company. Dunlop, who was born at Dreghorn, in Ayrshire, became a student at the Edinburgh Veterinary College and in 1867 started in practice as a veterinary surgeon in Belfast. It was while living at 28 May Street in that city that he made his first pneumatic tyre and applied it to his son's tricycle. the following year, 1889, Harvey du Cros (1846–1918) formed a company in Dublin for the manufacture of pneumatic tyres and from this has sprung the world-wide tyre industry of to-day. There are already memorials to Dunlop in Edinburgh and Belfast. The memorial to Aspdin consists of a plaque and memorial gates at St. John's Church, Wakefield, where the inventor is buried. Aspdin was born in Leeds and became a stonemason. His patent for Portland cement is dated October 21, 1824, and on the hundredth anniversary of that day the president of the American Portland Cement Association, Mr. F. M. Kelley, unveiled a bronze tablet to the memory of Aspdin, which the Association had erected on the plinth of two of the columns supporting the roof of the Leeds Town Hall. The memorial at Wakefield was dedicated by the Bishop of Wakefield and unveiled by Lord Wolmer on behalf of the Cement and Concrete Association. Little is known of Aspdin's career. After taking out his patent he started manufacturing cement at Wakefield, and one of the first

important structures in which it was used was Brunel's Thames tunnel. Aspdin's son, William (1816–64), played a considerable part in the development of the cement industry and erected works in Germany, where he died.

British School of Archæology at Athens

AT the annual meeting of the British School of Archæology at Athens, which was held at Burlington House, Piccadilly, London, W.1, on November 29, when the Crown Prince of Sweden was in the chair, Mr. J. D. S. Pendlebury gave an account of his recent excavation of the city of Karphi in Crete. This was one of the cities on the hills surrounding the plain of Lasithi; and its great interest lay in the fact that it contained an example of a large house, which probably dated from within two generations of the Trojan War, and thus afforded an excellent illustration of the house of Homeric times. The city was situated on an exposed spot with cliffs on three sides, that on the north having a sheer drop of 2,000 feet. It contained two cemeteries, a temple, and among other buildings, as already mentioned, a house, the largest of the period yet found. It is interesting to note that the roofing system of the whole town is that still in use among Cretan peasants. It would appear that bronze age civilization came to an end in Crete about 1100 B.C., when there was an invasion of people from outside, who introduced the Greek language, and settled at first near the sea. The old Minoans found sanctuary in the hills, where they continued to live on. Occupation at Karphi came to an end some two hundred years later, at about 900 B.C. Its evacuation, apparently, was peaceful, its inhabitants, no doubt, then considering it safe to live in a less exposed situation. In the course of the meeting, two announcements of no little importance were made. Prof. J. L. Myres, in moving the adoption of the annual report, stated that news had been received by the last mail of the discovery of an important Minoan tomb at Knossos, which was to be investigated at once; and Sir John Forsdyke announced that owing to the increase in the Government grant from £500 to £1,000 per annum, and the coming into operation of the Richard B. Seager bequest, the activities of the School in excavation would be considerably extended in the coming year.

Woad Mills

AMONGST the many at one time flourishing industries connected with agriculture carried on in Great Britain was that of the cultivation and preparation of woad, and in a paper read by Mr. Rex Wailes before the Junior Institution of Engineers on November 25 is described its cultivation in gradually decreasing quantities down to 1932, when the last crop in the world was gathered at Boston in Lincolnshire and prepared for market. Woad has been grown for centuries in Great Britain and prepared for market as a mordant or fixer for indigo dye. Its use in dyeing requires much skill, and its preparation is a lengthy process. The plant rapidly exhausts the soil in which it is grown, necessitating frequent removal of the woad mill and appurtenances to fresh sites. As in the case of many ancient industries, the woad mill evolved by village craftsmen seems peculiarly well fitted for its purpose. It ground the leaves into small pieces and after about an hour the mill was stopped and the pulped mass taken out and kneaded into balls about 6 in. in diameter; these were stacked on trays in open tiers of gratings where they dried for some weeks, and were then removed to store-rooms preparatory to couching, the most difficult operation in the preparation of woad. The balls were first broken up by the rollers in the roller house and then taken to the couching barn near by and spread on the floor to a depth of about 3 ft., watered, and allowed to ferment. During this process, temperature was carefully controlled and not allowed to exceed 125° F. The woad was turned daily at first and less frequently thereafter, the total time being 6–8 weeks. After couching, the woad was dried and rammed into barrels, its appearance then being like compressed peat or plug tobacco.

Technical Training at Leeds

THE City of Leeds College of Technology enrolled in 1937–38 more than four thousand students, of whom all except 14 per cent attended evening classes only. In a report presented by the Principal on the occasion of a distribution of awards by Prof. Lancelot Hogben on November 29, an appeal was made to employers to promote a largely increased attendance at part-time day courses of technical training in principles. That serious practical difficulties stand in the way of large-scale releases of employees for this purpose was freely admitted, but few would be found to deny that there is a crying need for constructive effort to make good the gaps in vocational education resulting from the obsolescence of the apprenticeship system in industry. "In the great majority of trades at the present day the only 'qualification' for receiving the pay and status of a journeyman is the attainment of the age of 21." The Principal wants industrialists to co-operate with the College in devising schemes, separate for each trade, such as are already in operation in the engineering trade in the Midlands, for issuing some agreed form of 'apprenticeship certificate' giving full recognition to workshop training as well as to technical college work.

Standard Time

THE recent unveiling in Toronto, announced in *The Times*, of a bronze plaque of Sir Sandford Fleming, recalls that it was only sixty years ago that he proposed the system of standard time now universally used. The advent of railways and telegraphs to North America made the continued use of local time an inconvenient practice. The railways began to use their own time, which was seldom in accord with the local time of any place on the line. When more than one railway served a town, there were usually two or more railway times as well as the local time, and confusion was rife. Fleming, who was a Scot, became chief engineer of the Canadian Pacific Railway, and

he realized that something must be done to end this state of confusion. In 1878, he proposed to the Canadian Institute in Toronto that the solution lay in dividing the globe into 24 time belts each of fifteen degrees of longitude, each belt to mark a difference of one hour in time. The Marquis of Lorne, at that time the Governor-General, submitted the proposal to the British Government, which, however, did not approve. The Tsar of Russia then initiated an international conference in Vienna in 1881 to discuss the matter. This led to a second conference in Washington in 1884 and the almost universal adoption of the proposal after the railways of Canada and the United States had already put standard time into use.

Ramsay Memorial Fellowship

THE following Ramsay Memorial fellowships for the year 1938–39 have recently been awarded: Dr. Vernon Hollis Booth, a British fellowship of £300, tenable for two years, at the University of Cambridge; Mr. Donald McNeil, a Glasgow fellowship of £300, tenable for two years at the University of Glasgow; Dr. Alfred Eppreeht, a Swiss fellowship of £300, tenable for one year, at the Imperial College of Science and Technology, London. The Trustees have renewed the following fellowships for a second year: Dr. A. E. Alexander (British fellow), at the University of Cambridge; Dr. E. de Salas (Spanish fellow), at University College, London; Dr. J. J. Hermans (Netherland fellow), at University College London; M. Jean Monvoisin (French fellow) at the Royal Institution, London; Mr. Hazime Oosaka (Japanese fellow), at University College, London; Dr. E. C. Stathis (Greek fellow), at the Imperial College of Science and Technology, London.

Announcements

PROF. H. SHAPLEY, director of the Harvard College Observatory, Cambridge, Mass., has been elected a member in the Section of Astronomy, and Prince Louis-Victor de Broglie, of the Institut Poincaré, Paris, a member in the Section of Physics, of the Royal Swedish Academy of Sciences.

PROF. EMILE ARGAND, professor of geology, mineralogy, petrography and palæontoology in the University of Neuchâtel, and Dr. E. A. Stensiö, director of the Department of Palæozoology in the Naturhistoriska Riksmuseum, Stockholm, have been elected foreign fellows of the Geological Society of London. Prof. H. von Eckermann, assistant professor of mineralogy and crystallography in the University of Stockholm, Prof. D. W. Johnson, professor of physiography in Columbia University, and Prof. A. A. Öpik, professor of geology in the University of Esthonia, have been elected foreign correspondents.

AT a meeting of the Royal Society of Edinburgh held on December 5, the president, Sir D'Arcy Thompson, showed and gave to the Society a copy of the billet of the corresponding meeting sixty years ago (December 16, 1878), when he had read a paper "On Ulodendron and Halonia" to the Society. This paper, communicated by Sir Wyville Thomson, was afterwards published by the Geological Society of Edinburgh, along with a plate drawn by another young man, known later on to all geologists as Benjamin Peach.

HONORARY degrees have recently been conferred by the University of Paris on the following: Prof. Szent-Györgi, professor of medical chemistry in the University of Szeged faculty of medicine, Dr. S. P. L. Sörensen, director of the chemical section of the Carlsberg Laboratory, Copenhagen, and Dr. Karrer, director of the Institute of Chemistry, University of Zurich.

PROF. JULES BORDET, director of the Pasteur Institute of Brussels, was presented with the Grand Cross of the Legion of Honour at the opening meeting of the Congress of the Association of French-speaking Microbiologists.

THE Sir Frederick Hobday Presentation Fund has now reached its first £1,000, contributed by about 850 subscribers. The committee has decided to continue its work in order to obtain the amount necessary for the object which Sir Frederick Hobday had in view, namely, the endowment of a chair of comparative medicine. Subscriptions should be sent to the honorary secretary, Mr. E. T. Cox, 3 St. John's Avenue, S.W.15.

THE Annual Conference of the Geographical Association will be held at the London School of Economics on January 3–6, 1939, under the presidency of Sir Thomas Holland. The subject of Sir Thomas's address will be "The Geography of Minerals". Further information can be obtained from the Clerk, Geographical Association, Municipal High School of Commerce, Princess Street, Manchester, 1.

THE annual meeting of the Institute of British Geographers will be held in the London School of Economics on January 5–6. Further information can be obtained from Mr. J. N. L. Baker, The University, Oxford.

THE twenty-seventh annual Conference of Educational Associations will be held at University College, London, W.C.1, on January 2–9, 1939, under the presidency of the Right Hon. Lord Macmillan. The subject of the presidential address will be "The Function of the University". A joint conference on "The University in a Changing World" will be held on January 5. Further information can be obtained from the Conference Secretary, Gordon House, 29 Gordon Square, W.C.1.

THE Cambridge University Press is to publish shortly "Karl Pearson", a memoir consisting of two articles by his son. It surveys his life from his earliest days, giving extracts from letters to show the development of his philosophy, and details of his many activities. It is illustrated with many portraits, and there are appendixes summarizing his unpublished lectures and reports.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 1041.

Blue Sunlit Aurora Rays and their Spectrum

IN the morning of September 15 last, between 3^h and 4^h M.E.T. (sunrise in Oslo, 5^h45^m), blue sunlit aurora rays were observed, like those of March 23, 1920[1]. Simultaneous photographs from two stations showed that the blue part was lying from about 250 km. to 650 km. above the earth. We succeeded in taking some good spectra which were very similar to a most interesting spectrum taken by Lord Rayleigh[2] of the aurora of May 14, 1921. In Fig. 1 is seen the spectrum taken on Agfa Isopan plate *ISS*, exposure from 2^h35^m to 3^h55^m, of the summits of sunlit aurora rays among which the greater part were blue. The small spectrograph used was loaned by the Auroral Observatory in Tromsö. The wave-lengths have been measured by Dr. Harang and are written above the spectrum.

TABLE 1. RELATIVE INTENSITIES.

Blue sunlit rays		Strong curtains in shadow	
6550 A.	Not well separated from the next one.	6550 A.	27
6300	245	6300	29
5577	100	5577	100
4708	56	4708	no trace
4278	130	4278	20
3914	173	3914	25

TABLE 2. RELATIVE INTENSITIES.

Wave-length (A.)	Blue rays	Common aurora (Vegard)
4708	100	100
4652	97	59
4596	85	44
4551	70	26
4278	100	100
4236	59	24
4200	35	8

In Fig. 2 is seen a spectrum of the same rays, with another spectrum of lower yellow-green curtains in the earth's shadow, going down to about 92 km. Both spectra were taken on Agfa Isopan *ISS* of the same stock with a spectrograph of great light power but small dispersion.

All spectra were taken from my auroral station in Oslo by my assistant, Mr. Herlofson.

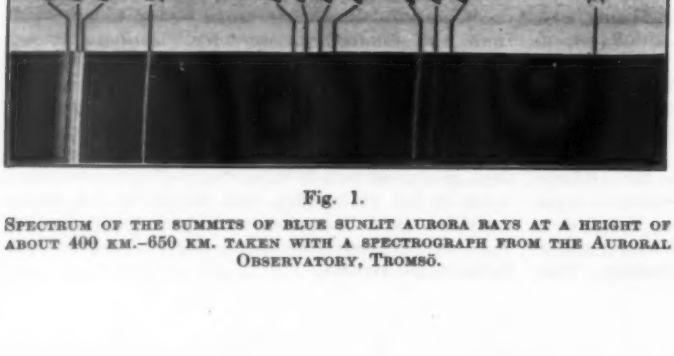


Fig. 1.

SPECTRUM OF THE SUMMITS OF BLUE SUNLIT AURORA RAYS AT A HEIGHT OF ABOUT 400 KM.–650 KM. TAKEN WITH A SPECTROGRAPH FROM THE AURORAL OBSERVATORY, TROMSÖ.

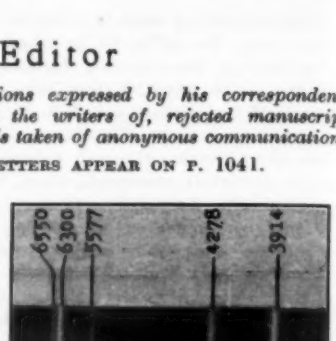


Fig. 2.

SPECTRA TAKEN WITH A 60° PRISM SPECTROGRAPH AND SMALL DISPERSION: ABOVE, THE SAME BLUE SUNLIT AURORA RAYS AS IN FIG. 1; BELOW, YELLOW-GREEN CURTAINS, HEIGHT OF LOWER BORDER ABOUT 92 KM.

By courtesy of my colleague, V. M. Goldschmidt, records were made of these spectra using his large Zeiss photometer. I am indebted to Dr. Oftedal for doing this work and to Mr. Herlofson for measuring the photometer records. Table 1 shows the great difference between the two spectra in Fig. 2.

From this it is seen that either the relative intensity of 6300 to 5577 A. has increased 8 times, of 4278 A. 6·5 times and of 3914 A. 7 times in going from the yellow-green curtains to the blue rays, or else that the intensity of the line 5577 A. has enormously decreased. This agrees with my visual observations[3] on March 23, 1920, and with Lord Rayleigh's observations on May 13–15, 1921, as regards the intensity of λ5577A. to 4278A. and 3914A.

Of special interest is the enhancement of a series of nitrogen bands in the blue and violet relative to the bands 4708 A. and 4278 A. seen in Fig. 1 as well as in the spectrum published by Lord Rayleigh. Table 2 gives the relative intensities for these bands, assuming absorption and plate sensitivity to be constant for each of the intervals 4551–4708 A. and 4200–4278 A., and the corresponding relative intensities for ordinary auroras according to Vegard[4].

CARL STÖRMER.

Institute of
Theoretical Astrophysics,
Blindern, V. Aker. Nov. 2.

[1] *Geofys. Pub.*, **4**, No. 7, 47 (1926).
[2] *Proc. Roy. Soc.*, A, **101** (1922).
[3] *Nord. Astr. Tidsk.*, **1**, 4 (1920).
[4] "Die Deutung der Nordlichterscheinungen, etc.," *Ergebnisse der exakten Naturwiss.*, **17**, 228 (1938).

Experimental Scrutiny of the Influence of Gravitation on Light

IT is remarkable how few decisive verifications of second-order relativity in physical systems have been effected: one can only recall the experiments of Michelson and Morley, Rayleigh and Brace, and FitzGerald and Trouton. It is therefore desirable that the very remarkable investigation by H. E. Ives and G. R. Stilwell, at the Bell Telephone Laboratories in New York, entitled "An Experimental Study of the Rate of a Moving Atomic Clock"[1], which has recently come into my hands, should not be overlooked. They have succeeded in measuring the second-order change in the free periods of the hydrogen atoms in canal rays flying transverse to the line of sight, which the finite speed of light demands, and in closely verifying the theoretical frequency factor $(1-v^2/c^2)^{1/2}$.

This is because the periods, when transposed from the observer's to the vibrator's own frame, should remain unaltered, if there is a universal standard of intervals of time, the same for all free vibrators.

We may pursue the subject into the influence of gravitation: if its field belongs to the vibratory system, the same invariance of period referred to the system itself ought to hold[2]. But it produces a velocity v given by the equation of scalar energy $\frac{1}{2}mv^2 = mV = \text{constant}$, where V is the potential of the field: hence we would infer that the field is responsible for a factor of change of frequency $(1+2V/c^2)^{1/2}$, so that the product of the two factors should be unity up to the second order.

This is just the expression for the influence of gravitation that has been adopted by the observing astronomers, following Einstein; but their efforts to verify it have been embarrassed by various disturbing influences.

It is to be noted that for vibrators in the gravitational field of the high solar atmosphere, v is negligible, for their downward motion is not free, as they are supported by collisional forces: it follows that such influences also produce their own changes in the frequency of vibration, which would be not easy to specify directly. This unsettles the results of stellar and nebular measures.

One notes that the transverse influences are verified on the periods of diatomic hydrogen and the elusive triatomic hydrogen, but the monatomic form does not appear. Null second-order effect of a uniform magnetic field is found, which agrees with theory, for such a field would not affect the circuital equations.

It comes out that the unmodified frequencies are exactly the same for the diatomic and the triatomic hydrogen vibrators, which as the experimenters remark is a significant result. The absence of monatomic hydrogen vibrators may perhaps be ascribed to the smallness of these particles and the resulting rarity of stimulating encounters.

JOSEPH LARMOR.

Holywood,
N. Ireland.
Nov. 11.

[1] *J. Optic. Soc. Amer.*, July 1938.

[2] Cf. a note "Universal Mental Time" by the writer in *Journal of Theological Studies*, Jan. 1938.

Reactivity of the Sulphur Linkage in Wool

PRESENT-DAY methods of imparting an unshrinkable finish to wool depend for their success on the formation of a gelatinous degradation product of keratin on or under the surface scale structure of the fibres. As a rule, the necessary degradation is brought about by chlorine, the layer of cortex immediately underlying the scales being attacked preferentially when an aqueous solution of chlorine is used[1]. The attack may, however, be restricted to the surface of the fibres by taking advantage of the inaccessibility of dry fibres to reagents of comparatively low molecular weight[2], as, for example, in the processes where gaseous chlorine[3], or solutions of chlorine in inert organic solvents, are applied to wool of low water content.

From first principles, it is evident that the degradation essential for unshrinkability must be realized by the fission of disulphide bonds or peptide linkages, the former being the more important. Apart from the fact that chlorine is known to cause disulphide bond breakdown, proof of this generalization is afforded by the fact that chlorine peroxide, which converts cystine into cysteic acid[4], imparts an unshrinkable finish to wool when applied from solution in carbon tetrachloride[5]. Further, since potassium permanganate, manganese heptoxide and Caro's acid can, under the correct conditions, be used to impart an unshrinkable finish to wool[6], it seems clear that any oxidizing agent capable of causing disulphide bond breakdown is *ipso facto* a potential agent for producing unshrinkability.

As regards the recent process utilizing a solution of sulphuryl chloride in white spirit[6], disulphide bond breakdown is again the cause of unshrinkability, because we have been able to show that sulphuryl chloride reacts with dibenzyl disulphide in the following manner at 37° C.:

$$\text{Ph-CH}_2\text{-S-S-CH}_2\text{-Ph} \rightarrow \text{Ph-CH}_2\text{-}\overset{\overset{\text{O}}{\|}}{\text{S}}\text{-S-CH}_2\text{-Ph} \rightarrow$$

$$\text{Ph-CH}_2\text{-SO}_2\text{Cl} + \text{Ph-CH}_2\text{Cl}.$$

Dibenzyl disulphoxide, benzyl sulphonyl chloride and benzyl chloride were isolated and identified as the main products of reaction under various conditions.

It seems clear, therefore, that any reagent capable of causing disulphide bond breakdown, preferably without reforming linkages between the peptide chains, may be utilized to impart an unshrinkable finish to wool.

For grants in aid of these investigations, which will be published in greater detail elsewhere, we are indebted to the Worshipful Company of Clothworkers (London) and the International Wool Publicity and Research Secretariat.

J. B. SPEAKMAN.
Textile Chemistry Laboratory, B. NILSSEN.
University, G. H. ELLIOTT.
Leeds.
Nov. 1.

[1] Speakman and Goodings, *J. Text. Inst.*, **17**, T 607 (1926).

[2] Speakman, *Trans. Faraday Soc.*, **26**, 61 (1930); *Proc. Roy. Soc.*, A, **132**, 167 (1931).

[3] Wool Industries Research Association, King, A. T., and Galley, R. A. E., B.P. 417, 719.

[4] Schmidt and Braunsdorf, *Ber.*, **55**, 1529 (1922); Schmidt, Haag and Sperling, *Ber.*, **58**, 1394 (1925).

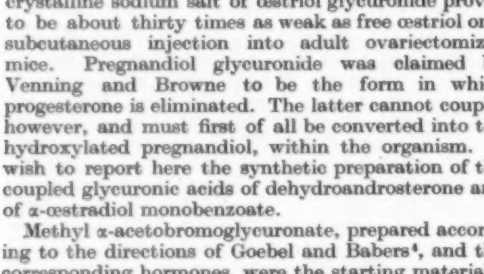
[5] Nilssen, Ph.D. Thesis, University of Leeds (1937).

[6] Hall, A. J., Hicking, W. N., and Pentecost, S. J., B.P. 464, 503.

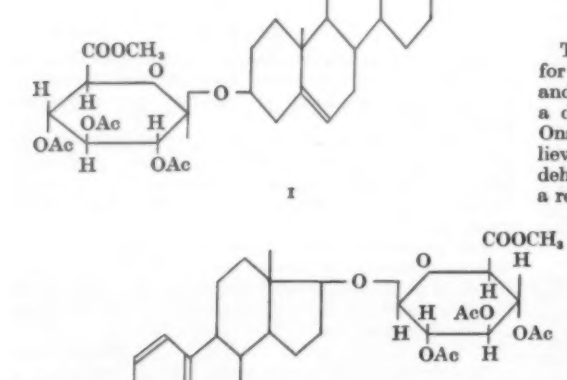
Synthesis of Sexual Hormone Glycuronides

THE importance of glycuronic acid lies in its property of condensing with hydroxylic compounds to produce the so-called coupled glycuronic acids. In this way these substances become soluble in water and therefore also in urine. From the researches of Cohen and Marrian[1], Cohen, Marrian and Odell[2], as well as those of Venning and Browne[3], glycuronic acid also plays a part in the mechanism of the elimination of the sex hormones. These investigators succeeded in isolating and identifying œstriol glycuronide in an amorphous form (Marrian), and pregnandiol glycuronide in a crystalline condition (Venning and Browne), from pregnancy urine. The crystalline sodium salt of œstriol glycuronide proved to be about thirty times as weak as free œstriol on a subcutaneous injection into adult ovariectomized mice. Pregnandiol glycuronide was claimed by Venning and Browne to be the form in which progesterone is eliminated. The latter cannot couple, however, and must first of all be converted into the hydroxylated pregnandiol, within the organism. I wish to report here the synthetic preparation of the coupled glycuronic acids of dehydroandrosterone and of α-œstradiol monobenzoate.

Methyl α-acetobromoglycuronate, prepared according to the directions of Goebel and Babers[4], and the corresponding hormones, were the starting materials. When the synthesis was carried out in indifferent media, such as, for example, benzene in presence of silver carbonate, condensation took place with the elimination of bromine and the simultaneous formation of an oxygen bridge and the production of the corresponding derivative of the hormone glycuronide. Thus dehydroandrosterone furnished the acetylated glycuronide of the constitution shown in (I), as a well-defined, crystalline substance, m.p. 194–196° (uncorr.) $[\alpha]_D^{25°} = -8{\cdot}4°$ in chloroform.



I



II

α-Œstradiol benzoate afforded a similar, well-defined, crystalline substance, m.p. 189–191° (uncorr.) with constitution shown in (II). This substance is optically inactive.

Hydrolysis with barium hydroxide in methyl alcoholic solution splits off the acetyl and the benzoyl as well as the methyl groups, with the production of the crystalline barium salts of the hormone glycuronide. The coupled hormone — glycuronic acids are obtained in glistening, mother-of-pearl-like scales by treating the barium salts with sulphuric acid.

(1) Dehydroandrosterone glycuronide melts at 262–264° (uncorr.), the colour turning brown and decomposition taking place.

(2) Œstradiol (17)-glycuronide melts after shrinkage at 191–194° (uncorr.) while the colour turns yellow and decomposition takes place.

On account of lack of material, the hormone glycuronides have not yet been obtained in an analytically pure state. They are fairly readily soluble in hot water.

The following preliminary data on the biological activity of the two preparations may be given. A daily dose of 20 γ of dehydroandrosterone glycuronide per capon dissolved in propylene glycol and smeared on the comb on each of four successive days was inactive. 77 γ per capon gave a sectional comb growth of 14 per cent after five days. 120 γ of œstradiol glycuronide, injected subcutaneously during 24 hours in three doses of 40 γ, produced heat in castrated mice; 12 γ was inactive. The considerable loss of activity of the substances in the form of a glycuronide compound is similar to that found by Marrian and collaborators for œstriol glycuronide.

We are now determining the physical constants of the analytically pure preparations and preparing other glycuronides.

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Oct. 3.

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Tyrosinase and Catechol Oxidase

THE nature of tyrosinase has been under discussion for a very long time. Raper and his school[1], Graubard and Nelson[2], and Keilin and Mann[3] believe it to be a distinct enzyme, different from catechol oxidase. Onslow and Robinson[4], McCance[5], and Richter[6] believe it to be a catechol oxidase plus *o*-chinone plus dehydrogenase. Kubowitz[7], whose work appeared in a recent issue of the *Biochemische Zeitschrift* whilst we were preparing for publication our results, states that it is identical with catechol oxidase. Recent books[8,9] appear to accept the first of these views.

The tyrosinase that we have worked with was extracted from *Sepia*. The action of the enzyme from this source has been shown by one of us[10] to be identical with that of Raper's mealworm tyrosinase. In agreement with most of the workers mentioned above, we have found that the partially purified tyrosinase acts on tyrosine with a very long induction period. This induction period can be reduced, as has long been known, by adding a trace of *o*-diphenol.

We have found that this 'activating effect' consists merely of the reduction of the induction period. After a short autocatalytic period, evidently depending on the quantity of the *o*-diphenol added, the reaction in the two systems proceeds at equal speeds.

Moreover, the rate of the oxidation process, as followed in Warburg respirometers, is linear for a very long time.

The simplest explanation of these facts lies in the assumption of an equilibrium:

Tyrosine + *o*-chinone ⇌ dioxyphenylalanine + catechol,

when catechol is added to the system. This has been demonstrated by simple chemical means, in the absence of an enzyme, by the addition of a recently prepared *o*-chinone solution to a tyrosine solution and subsequent extraction with ether. We found a considerable decrease in the concentration of tyrosine, and a proportional increase in the concentration of diphenol.

Thus we think that the only enzymatic step in the phenol oxidation is the dehydrogenation of the diphenols in the corresponding *o*-chinone; whilst the oxidation of the monophenols in the corresponding *o*-diphenols is a simple chemical process occurring automatically. These results suggest that the presumption of a tyrosinase (monophenolase) is not necessary to explain the tyrosine (monophenol) oxidation, and consequently tyrosinase (monophenolase) need not exist at all.

Details of our work will shortly appear elsewhere.

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Nov. 11.

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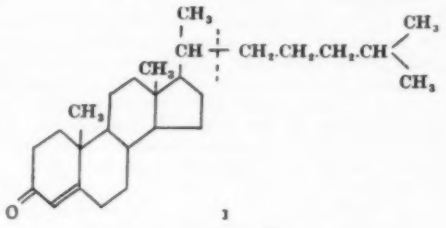
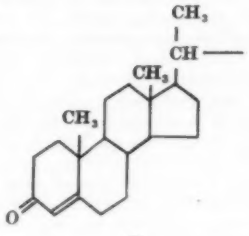
Photochemistry of Δ^4-Cholestenone

THE carcinogenic properties of œstrone, and the close structural relationship between the powerful carcinogenic hydrocarbon methylcholanthrene and the steroids, makes the hypothesis appear justified that perhaps light-cancer of the skin is due to photochemical conversion of steroids situated in the skin into carcinogenic products. We have therefore, in collaboration with Prof. L. Halberstaedter (Jerusalem), begun to investigate the changes brought about by ultra-violet irradiation of steroids, and report here our results with Δ^4-cholestenone (I).

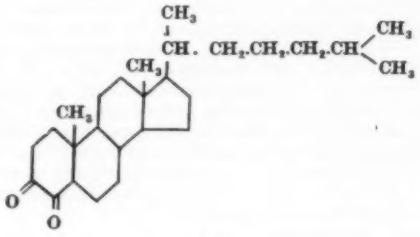
So far, only sterols seem to have been investigated in this way (ergosterol, cholesterol), but recently the photo-oxidation of a hydrocarbon, $\Delta^{3,5}$-cholestadiene, leading to a peroxide, has been studied by Skau and W. Bergmann[1] and by Butenandt and Kudszus[2]. When a hexane solution (5 per cent) of Δ^4-cholestenone[3] is exposed to the full light of a mercury arc[4], the formation of an insoluble, well-crystallized substance sets in immediately. (The same phenomenon has been observed in benzene solution.) This substance, which proves insoluble also in the other usual organic solvents, is conveniently recrystallized from ethyl malonate or ethyl succinate, forming needles not melting up to 360° C. The high melting point, insolubility and analysis point to a dimolecular reaction product (formally analogous to ergopinacol and similar substances); the analyses seem to prove the formula $C_{45}H_{62}O_2$ (calc. C, 84·2; H, 10·3; found: C, 83·85; 83·97; 83·62; 84·19; H, 11·0; 11·0; 10·7; 10·5), which is derived from



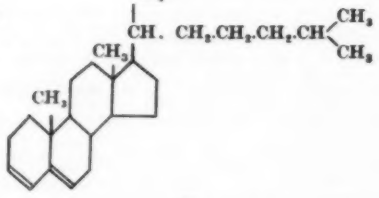
I



II



III



IV

cholestenone (I) by loss of six carbon atoms and dimerization of the remainder of the molecule.

The insolubility of the substance has prevented so far the elucidation of its structure by degradation reactions; so it can only tentatively be assumed that the side chain of (I) is split at C_{20} and dimerization occurs at this point (II). If so, the skeleton of progesterone is formed from that of cholesterol—so far no conclusive attempts have been reported to convert cholesterol into sex hormones by biological means[5]—and our observation is an interesting analogue of the photochemical decomposition of the side-chain in lactoflavin to form 'lumi-lactoflavin'[6]; but in this case hydrogenation of the involved carbon atom occurs instead of dimerization.

The formation of the high-molecular product (II) is accompanied by the production of a resinous by-product, which separates partly on the walls of the

quartz vessel and prevents further interaction with the mercury radiation; when the vessel is emptied and cleaned, the solution deposits anew the above substance. The nature of this by-product has not been elucidated.

When in the irradiation of cholestenone (I) oxygen is not rigidly excluded, a second product is formed through photo-oxidation. It can be isolated from the hexane mother-liquor of (II) by evaporation, trituration of the residue with isopropylalcohol and recrystallization of the insoluble part from butyl alcohol, and forms prismatic needles, m.p. 157° C. ($[\alpha]_D = +23{\cdot}3°$ in chloroform). According to the analysis (found: C, 80·8; 80·3; H, 11·0; 10·9; calc. for $C_{27}H_{44}O_2$: C, 81·0; H, 11·0 per cent), the substance is the known[7] cholestane-3-4-dione (III); like the substance itself, its condensation product with *o*-phenylene-diamine, however, showed a higher m.p. (228°, from isopropyl alcohol) than recorded in the literature (found: N, 5·8; calc. for $C_{33}H_{48}N_2$: N, 5·9 per cent). The course of this photo-oxidation is analogous to the formation by means of selenium dioxide of 3.4-dihydroxy-derivatives from cholesterol and dihydro-ergosterol[8].

Finally, it may be put on record that cholesteryl acetate, on irradiation, is mostly resinified; from the resin, it has been possible in some instances to isolate—by distillation *in vacuo* (b.p. 228–230°/2 mm.) and trituration of the distillate with methanol and acetone—$\Delta^{2,5}$-cholestadiene (IV)[9], from acetone, m.p. 76°, $[\alpha]_D = -100°$ in chloroform (found: 88·0; H, 11·9; calc. for $C_{27}H_{44}$: C, 88·0; H, 12·0 per cent). As cholesteryl acetate can be distilled without decomposition, the hydrocarbon would have been formed by irradiation or, more likely, during distillation from a less stable photo-product.

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[3] Prepared according to Schoenheimer, *J. Biol. Chem.*, **110**, 461 (1935). It is most conveniently purified by distillation *in vacuo* (b.p. 245°/0·03 mm.) and recrystallization from isopropyl alcohol.
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Effect of Growth Substances on Growth and Fruiting of *Melanospora destruens*

IT has been shown[1] that a strain of the ascomycete *Melanospora destruens* which makes only negligible growth on a synthetic medium will grow vigorously and will produce perithecia on a similar medium to which a crude extract of lentils is added.

Schopfer[2], Robbins and Kavanagh[3] and others have shown that the addition of vitamin B_1 to a synthetic medium will promote growth of *Phycomyces Blakesleeanus* and some other fungi.

Wildiers[4] in 1901 showed that a growth substance which he called 'bios' was essential for the development of certain yeasts. Later Eastcott[5] was able to split up bios into two parts one of which was identified as inositol. Similarly, Buston and Pramanik[6] fractionated the growth substance necessary for the development of *Nematospora gossypii* into an inositol fraction and an inositol-free fraction. Kögl and co-workers have recently isolated a substance 'biotin,' with bios activity, from egg yolk and have shown that while inositol, biotin and aneurin (vitamin B_1) are necessary for maximum growth of some yeasts, certain other fungi require only aneurin[7].

Through the kindness of Prof. Kögl of Utrecht, I have been able to test the effect of biotin on *M. destruens*. A preparation of vitamin B_1 was also used.

The strain of *Melanospora* used made negligible growth and produced no perithecia on a medium containing glucose, potassium nitrate, magnesium sulphate and potassium dihydrogen phosphate. The addition of various amounts of vitamin B_1 to this medium had no effect on the fungus. When pure biotin methyl-ester was added to the synthetic medium, the *Melanospora* made good mycelial growth but produced no perithecia. Growth and perithecial production were both good if both biotin and aneurin were added to the medium. Thus these two growth substances have different effects on this fungus, biotin being necessary and sufficient for good vegetative growth and aneurin being necessary for the production of perithecia.

The addition of inositol had no effect on either growth or fruiting.

It is hoped to publish a fuller account of this work soon.

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Nov. 11.

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Genetics of *Armadillidium vulgare* Latr.

THERE are several varieties of the isopod *Armadillidium vulgare* Latr. The colour of the commoner ones is either black or greyish. A reddish-brown variety also occurs. I have obtained occasional specimens of this variety (var. *rufobrunneus* Collinge[1]) from four different localities near Cambridge. As can be seen from the accompanying table, this red colour appears to be a simple dominant to the commoner black colour (both the red male *A* and the red female *B* are heterozygous for this factor).

Brood	Parents	Progeny
1 of 1937	Red male *A* × Red female *B*	27 red : 13 black
1 of 1938	Red male *A* × Black female *C*	4 red : 8 black
3 of 1938	Red male *A* × Black female *D*	5 red : 11 black
2 of 1938	Black male *E* × Red female *B*	5 red : 5 black

The apparent small size of the three broods in 1938 is due to the death of animals before they can be scored caused by faulty cultural methods.

Brood 1 of 1937 was also scored for sex. There were found 36 females but only one male (three animals died after having been examined for colour and before their sex was determined). The red female *B* thus appears to be thelygenic. Vandel[2]

has described in some detail the occurrence of amphogenic and monogenic (both arrhenogenic and thelygenic) females in another terrestrial isopod, *Trichoniscus provisorius* Racovitza. The apparently normal 3 : 1 segregation for colour in this brood would not be expected if this brood were a parthenogenetic one such as are known to occur in triploid *Trichoniscus elisabethæ* Herold (Vandel[3]).

The 'exceptional' male in Brood 1 of 1938 was of the black type with a pattern of yellow markings (var. *variegatus* Lereb., see Collinge[4]). Such a variety appears, from collections and also from observations on the segregations in amphogenic broods, to be normally a sex-limited character found only in females. Most males are entirely black in colour (var. *plumbeus* Lereb., see Collinge[4]). All the red and black females in this brood also had the pattern of yellow markings.

Work on the genetics of the different varieties of this woodlice is being continued, and it is also proposed to investigate the genetics of the amphogenic and monogenic types of females. Such work must be slow since only one brood per year is obtained.

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[3] Vandel, *Bull. biol.*, **68**, 418 (1934).
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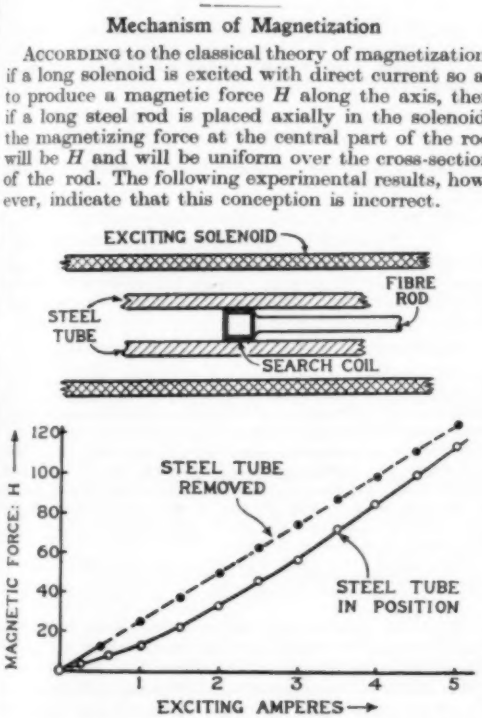
Mechanism of Magnetization

ACCORDING to the classical theory of magnetization, if a long solenoid is excited with direct current so as to produce a magnetic force H along the axis, then if a long steel rod is placed axially in the solenoid, the magnetizing force at the central part of the rod will be H and will be uniform over the cross-section of the rod. The following experimental results, however, indicate that this conception is incorrect.



A solid-drawn steel tube 24 in. long, ¾ in. outside diameter and ⅝ in. inside diameter was arranged axially and centrally in a magnetizing solenoid about 4 ft. 9 in. long and about 4½ in. internal diameter. A search coil wound on a fibre rod support was arranged inside the steel tube midway between the two ends, the general arrangement being as shown in the diagram. The magnetic force inside the tube was then measured ballistically and the results are shown by the full-line curve, which has been plotted as a function of the exciting current of the solenoid. The steel tube was then removed whilst the search coil remained in position centrally in the solenoid. The magnetic force was then measured ballistically, and the values so obtained are shown by the broken straight line in the graph.

It appears therefore that, for a given excitation, the magnetic force H inside the tube may be only about one half the value which is obtained when the steel tube is removed.

These investigations are being extended by using a nest of tubes arranged with an annular space between every two consecutive tubes so that the magnetic force may be measured in each of the annular spaces.

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Friction of Clean Metals and the Influence of Surface Films

WHEN a metal is cleaned in air, the surface will still be covered with a relatively thick layer of oxide and other adsorbed impurities. Friction measurements are usually made with metals coated in this way, and if a lubricant is added, it is superimposed on the surface films already present. Recent experiments[1] show that an intermittent clutching and breaking away of the surfaces takes place during sliding. The results suggest that local adhesions may occur at the points of metallic contact, and that the sliding friction may be due to the making and breaking of these welded junctions. The molecular field of force at the surface of a solid is profoundly modified by the presence of an adsorbed layer, so that, if this view is correct, we should expect the surface film to have a large influence on the friction.

It is a matter of considerable experimental difficulty to remove the last traces of adsorbed film from a metal surface, and few attempts to measure the kinetic friction of naked metals have been made. Jacob[2], and Shaw and Leavey[3] found that when metal surfaces were partially cleaned in a vacuum the *static* friction showed an increase. Holm and Kirschstein[4] showed that the adhesion between metals which had been heated in a vacuum was high. On the other hand, Pöschl[5] states that when surfaces are cleaned in a good vacuum the sliding friction between the surfaces becomes vanishingly small. We have measured the *kinetic* friction between various metal surfaces which have been cleaned by prolonged heating, in a high vacuum, to a temperature near the volatilization point. Within the limits of experimental accuracy, the friction was independent of the sliding speed, and in every case the removal of the surface films caused a very large increase in the friction. The coefficient of kinetic friction between outgassed nickel and tungsten surfaces, for example, was $\mu = 6$, which is nearly twenty times greater than the friction of these metals when 'cleaned' in the ordinary way.

These observations lend strong support to the view that local adhesion between metals may occur. Under normal conditions, when the metals are exposed to the air, the presence of adsorbed films will reduce

the field of force at the surface. When this film is removed, the strength of the field is increased, the metals are able to approach more closely, and the molecular interaction and adhesion are very much greater.

The effect of adding gases and vapours to the outgassed metals was interesting. Hydrogen and nitrogen had very little influence: the friction remained at its high value even after prolonged standing. The admission of a trace of oxygen, water vapour, or caproic acid vapour all produced an immediate fall. This suggests that the presence of a primary film is capable of reducing the friction between the metals. In most cases, however, this initial rapid fall was comparatively small, and the friction continued to decrease with time. It was not until thicker films were built up on the surface that the friction fell to values near those observed under normal conditions of measurement. In the case of copper, for example, it was necessary to form a visible oxide film before the friction fell to $\mu = 0{\cdot}6$. Caproic acid vapour behaved in a similar way. After the small initial rapid drop in the friction, there was little further change until the surface was allowed to stand for some time in the vapour at its saturation pressure, so that condensation could build up polymolecular layers of the fatty acid. The friction then fell to a low value comparable with that observed under 'boundary lubrication' conditions ($\mu = c.\ 0{\cdot}1$).

The view was originally put forward by Hardy[6] that under 'boundary lubrication' conditions the solids were separated only by a unimolecular film adsorbed on each surface, and that the *static* friction was due to the interaction of these two adsorbed layers. Other experiments[7] have shown that the *kinetic* friction under boundary lubrication conditions cannot be regarded as a purely surface phenomenon. It is much more complicated and the effects extend to a considerable depth beneath the surface of the solid. These observations support this view, and suggest that the primary film is not enough, and that a layer of the substance several molecules in thickness must be present before it can function as an effective boundary lubricant for moving surfaces.

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T. P. HUGHES.

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Cambridge. Nov. 11.

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[5] Pöschl, see p. 71, Ewald, Pöschl and Prandtl, "The Physics of Solids and Fluids" (Blackie, 1930).
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Verses about Buckland

IN view of the interest recently displayed in an "Elegy, intended for Professor Buckland" (NATURE, Oct. 8, p. 673, and Oct. 22, p. 758), it may be appropriate to record Buckland's own comment upon it in a letter which he wrote to Miss Jane Talbot at Penrice Castle in Gower on December 11, 1820. Buckland had just returned from a long Continental trip which, he said, had been "less adventurous in the line of imprisonments and banditti than the last, but had not been lacking in curious incidents". He then went on: "In contemplation of the possibility of my remaining underground upon the Continent for ever, I found upon my return that Mr. Whateley of Oriel had composed for me an elegy which I am happy to have it in my power to forward you a copy." The copy which follows, in his own handwriting, shows that the printed versions in Mrs. Gordon's "Life and Correspondence of William Buckland", and in NATURE of October 8, contain a few copyists' errors.

There was also printed in "The Life . . . of Buckland" a rhyming account of one of his lectures, said to have been delivered early in 1822. The lines were, however, written earlier than this, as they are mentioned in a letter which Buckland wrote to Lady Mary Cole, also of Penrice, on October 29, 1819. He was writing from Axminster and said: "I received last week a poetical epistle from my friend Mr. Shuttleworth containing one of my lectures done into rhyme. It is extremely neat and full of humour, and will be highly entertaining to you."

Part of the epistle is printed in "The Life . . . of Buckland", and it describes in rhyme how the tutors and undergraduates sat beneath "Ashmole's ample dome" while "the inventive Master" discoursed upon the history of the earth and the life it had supported in past ages. This part which is omitted from Mrs. Gordon's book is as follows:

"Allow me now that map of mine to show,—
'Tis Glostershire ten thousand years ago—
. . . . .

It being the object of the versifier to produce at present merely a specimen of his intended work, he has omitted the following fifty verses, exclusively geological, concluding with:

Those Bones I brought from Germany myself
You'll find fresh specimens on yonder shelf,

and also a digression of 2,300 lines of which the concluding couplet is:

So, curl the tails of puppies and of hogs
From left to right the pigs, from right to left the Dogs,

and also for the same reason, the subsequent and still more digressive digression, which is terminated by the following admirable reflexion—the whole passage consisting of 5,700 fresh lines:

And not wild, but *tame* cats only, teaze their prey.

The concluding couplet which is given without any alteration from the mouth of the learned Lecturer is here subjoined solely because it serves as an additional proof, if such were wanting, of the close connexion which subsists between geological speculations and not the ideas only, but also the language, of complete poetry. It will be observed that tho' intended only as a common sentence of adjournment, it has all the fluency and grace of the most perfect rhythm, and of its own accord 'glides into sense and hitches in a rhyme':

Of this enough—on Secondary Rock
To-morrow, Gentlemen—at 2 o'clock."

Buckland derived considerable pleasure from the verses which he inspired, and in a letter to Lady Mary Cole he wrote: "I believe few ladies have given origin to more poetry than my bag and hammer. I enclose you copies of one or two by Mr. Duncan and Mr. Conybeare, and you that have seen my rooms will judge of the accuracy of the description of them." The lines by Duncan are those on the "Comforts of a Professor's Rooms in Oxford", printed in "The Life . . . of Buckland" (p. 9), while Conybeare's effusion is as follows:

ODE TO A PROFESSOR'S HAMMER

Hail to the hammer of Science profound,
Flint Stone and Rock
Quail at its shock,
And their fragments fly as the sparks around.

Beneath the storm of its thundering blows,
Rending and opening and staggering and reeling,
Mountains reluctant their story disclose,
The secrets of Millions of Ages revealing.
The fossil dead that so long have slept,
And seen world after world into ruin swept,
Start at the sound
Of its fearful rebound.

Though fathoms deep in adamantine fold
The solid Rocks their fast bound corpses hold,
Though every age—and thousands since have past—
Hath made that sepulchre more deep, more fast,
Yields the firm Rock, and through the rifted stones
Pours the strange light on the long shrouded bones.

A Sun—not that whose earlier Ray
Illumined their primæval day,
But younger many a generation—
Their sun's great Grandson at the least,
Shines on each antiquated beast,
And now first wakes their slumbering nation.

Each old crocodile grins with vast amaze
While rousing him from his marble hearse,
As a world so new and so strange he surveys;
And doubtless he thinks that since his younger days
Things are strikingly changed for the Worse.

The manuscripts upon which the foregoing notes are based are in the Department of Geology at the National Museum of Wales, having been presented to that Institution by Dr. Mervyn Gordon.

F. J. NORTH.

National Museum of Wales,
Cardiff. Nov. 9.

Binocular Vision

THE ability to see stereoscopic pictures without a stereoscope, referred to by Mr. G. R. R. Bray in NATURE of Nov. 26, p. 959, is, if not common, at least fairly easy to acquire. I have been able to view such pictures, with naked eyesight, for many years past. If one places a pair of stereoscopic pictures at the normal distance from the eyes for comfortable vision, and then directs one's gaze just over the top of the pictures at some more distant object, two images of each of the pictures will immediately appear. By a little practice, the right hand image of the left picture and the left hand image of the right picture can be brought into coincidence, the coincidence occurring rather suddenly in the end, and, as it were, *engaging* in that position. This sudden coalescence is, I presume, due to the eyes refocusing at normal distance each on its own picture. When this has occurred the equilibrium is fairly stable.

I have sometimes thought that it might be possible to teach this little accomplishment to an audience, and then to exhibit stereoscopic pictures in this way on the screen.

T. S. PATTERSON.

Organic Chemistry Department,
University of Glasgow.

Points from Foregoing Letters

PHOTOGRAPHS of spectra of blue auroras at a height of 250–650 km., taken at Oslo, Norway, on September 15 last, are submitted by Prof. C. Störmer. By comparison with the lower (92 km. high) yellow-green curtains of the auroras in the earth's shadow, the spectra of the blue auroras show that the relative intensity of the lines 6300, 4278 and 3914 A. has increased considerably (6–8 times) as compared with the line 5577 A.

Sir Joseph Larmor directs attention to the work of Ives and Stilwell, who have measured the second-order change in the free periods of the hydrogen atoms in the canal rays flying transverse to the line of sight, thus verifying the theoretical frequency factor $(1 - v^2/c^2)^{1/2}$; he also discusses the second order effects that might be expected from the influence of gravitation upon light.

The unshrinkable finish imparted to wool by various processes depends on the formation of a gelatinous degradation product of keratin, on or under the scale structure of the fibres, according to Dr. J. B. Speakman, B. Nilsen and G. H. Elliott; they state that this may be accomplished by means of any reagent (such as chlorine) which is capable of breaking down the disulphide bonds.

Prof. L. Califano and D. Kertesz find that the 'activating effect' of *o*-diphenol upon the action of 'tyrosinase' extracted from *Sepia* is merely a reduction of the induction period; they consider that the assumption of the existence of a tyrosinase enzyme to explain the tyrosine oxidation is unnecessary.

Dr. E. Bergmann and Y. Hirshberg describe the changes brought about in Δ^4-cholestenone by ultra-violet irradiation. Besides resinous material, a bi-molecular reaction product, $C_{42}H_{64}O_2$, is formed by loss of six carbon atoms and dimerization.

Dr. Lilian E. Hawker finds that in order to grow the fungus *Melanospora destruens* on a synthetic medium composed of glucose, potassium nitrate, magnesium sulphate and potassium dihydrogen phosphate, it is necessary to add biotin (a growth substance obtained from egg-yolk) for good vegetative growth and aneurin (vitamin B) for the production of perithecia.

H. W. Howard reports that in the wood-louse *Armadillidium vulgare* Latr. a red variety behaves as a simple dominant to the commoner black form. In a brood of 37 which showed a 3 : 1 segregation, there were 36 females and only one male.

Measurements made by Dr. T. F. Wall of the magnetic force at the axis of a long solenoid, (i) when a steel tube is arranged axially in the solenoid and (ii) when the steel tube is removed, indicate that one aspect of the classical theory of magnetization is incorrect.

Dr. F. P. Bowden and T. P. Hughes find that when the adsorbed films normally present on metals are removed, the kinetic friction between them is very great and may be twenty times that usually observed. A layer several molecules in thickness must be present before a substance can function as an effective 'boundary' lubricant for moving surfaces.

Research Items

Modern Maya Houses of Central America

AN elaborate study of the modern Mayan house of Central America has been made by Mr. Robert Wauchope (Carnegie Inst., Washington, D.C., *Pub.* No. 502, 1938. Pp. 181, with 37 pl.) with special reference to its bearing on the archæological problem of the construction and arrangement of the dwelling house of the ancient Mayas. Archæological excavation, owing to the character of the structure, reveals little evidence, except of the substructures. Attention was directed especially to the manner in which the modern house falls to pieces. The close resemblance between the ancient house, as shown in the frescoes, and the modern house, has been pointed out frequently. Present-day Maya villages are probably assembled more systematically than those of ancient times, when they were either located at haphazard, or clustered in the neighbourhood of important buildings. There is evidence to suggest that the present-day practice was followed, according to which an owner builds on houses, additional to his own, to accommodate tenants for stipulated service. At present the isolated house is rare in Yucatan and Campeche, but common in Guatemala. The siting of a house is determined by the condition of the site, poor drainage, outcrops of rock, or rough surface being avoided. The floor is composed of the ground, levelled and improved by marl and earth. A low platform or substructure is erected to support the house. Some are provided with terraces. Most modern dwellings are of the single-room type, but there are also some with an enclosed room at the back and an open porch front, or with three or four rooms, facing on porches, and located side by side under a single roof. Houses in the Maya area are either apsidal, flat-sided with rounded corners, rectangular, square, or rounded in ground plan. The same plan in building is followed throughout. The mainposts of the house are well inside the line of the walls, and stand independently of the rest of the house-framing. Cross-beams rest on the forks of the mainposts, and carry the plates. The chief weakness of the Guatemalan house is in its long axis. The main types of roof are the hip roof and the gable roof. Practically all are quarter pitch. The use of adobe brick differentiates the houses of Honduras, Guatemala and highland Mexico from those of Yucatan, where rubble masonry, wet or dry, is in use. Windows are rare.

Decarboxylation by the Typhoid Bacillus

MADELEINE LACHAMPT (*Thèse de Paris*, 1938, No. 661) has investigated the action of *Bact. typhosum* on the two amino-acids, histidine and tyrosine, which are respectively capable of producing histamine and tyramine by decarbolization. The decarbolization of histidine which gives rise to histamine takes place as the result of the action of various micro-organisms, such as *B. aminophilus*, some strains of *Bact. coli*, *Bact. lactis aerogenes* and Friedländer's bacillus, and can also be produced by *Bact. typhosum* in a culture medium containing a source of carbon and nitrogen distinct from histidine. Decarbolization of tyrosine which gives rise to tyramine is produced by *B. aminophilus*, *Proteus vulgaris*, *Bact. lactis aerogenes* and *Bact. coli*, and can also be produced by *Bact. typhosum* in a medium containing a source of carbon and nitrogen distinct from tyrosine.

Japanese Martin Fly

THE black-chinned martin, *Delichon urbica dasypus* is infected by a house-fly, *Stenopteryx nipponica* (Fam. Hippoboscidæ) regarding the biology of which nothing has so far been published. The species, described by K. Kishida in 1931, seems to be limited to the black-chinned martin, for no specimen was found in the nests of swallows or other birds, although the nests of the martin were heavily infested, and a few individuals were found attached to the birds themselves. Kaoru Huziematu now describes the life-history in detail from observations made at Tubame Hotspring, Japan (*Sci. Rep. Tôhoku Imp. Univ.*, Ser. 4, 13, 59; 1938). Mating generally takes place while the flies are in the nest, and the egg hatches in the uterus of the female insect, where by contraction and dilation of a tongue-like organ the larva feeds upon glandular secretions. After three instars, the full-grown larva, now covered with a more or less chitinized skin, is deposited in the martin's nest. The pupal period in the summer is 23 days, but in the autumn after the emigration of the martins, puparia were found in the nests, and from these the adults do not emerge until the following spring. In this respect the pupal life-history resembles the stages of "Sommerpuppe" and "Winterpuppe" described by Hardenberg in *Stenopteryx hirundinis*, the corresponding parasite of the European house-martin.

A New Method of Development in Tufted Mosses

A CURIOUS problem in the genus *Plagiochila* has been the explanation of the small plantules known as *P. Stableri*, which occur in the vicinity of *P. asplenioides*. Douin (*Ann. Bryologici*, 11; 1938) has now shown that *P. asplenioides* develops axillary branch initials, the upper developing into normal branches, whilst the lower swell at the base and become detached. The latter fall on to lower leaves, soil and neighbouring mosses and there develop rhizoids and behave as small epiphytic or free-living plantules with the characteristics of *P. Stableri*. Douin considers the development of similar branch initials to be responsible for the multiplication of the erect stems of many tufted mosses. These are figured for *Funaria hygrometrica*. In *Bryum argenteum* spore production is not sufficiently common to account for the rapid spread and increase in size of tufts, and yet neighbouring stems of the tuft show no connexion with one another. Such deciduous branch initials would offer a satisfactory explanation of the prolific multiplication in such cases.

Epicentres of Recent Earthquakes

PROVISIONAL epicentres of three recent earthquakes have been determined by the United States Coast and Geodetic Survey in co-operation with Science Service and the Jesuit Seismological Association, from instrumental records obtained at U.S. Observatories. (*a*) 1938 Nov. 5 d. 8 h. 43·3 m. G.C.T., epicentre lat. 38° N., long. 141° E. There was a probable after-shock from the same epicentre on Nov. 5 d. 10 h. 50·2 m. G.C.T. These were recorded by twenty-three stations. (*b*) 1938 Nov. 6 d. 8 h. 53 m. 57 s. G.C.T., epicentre lat. 36° N., long. 144° E. There was apparently an aftershock from the same epicentre on

Nov. 6 d. 21 h. 38·7 m. G.C.T. These were recorded by twenty stations. (c) 1938, Nov. 10 d. 20 h. 18·7 m. G.C.T., epicentre lat. 56° N., long. 159° W. This was recorded by twenty-three stations. The first and second of these were off the north-east coast of the main island of Japan, and the third was immediately to the south of the Alaska Peninsula. All have been mentioned previously in NATURE.

Seismological Data and Volcanicity

E. M. ANDERSON applies seismological data to the magma problem in a paper delivered at the section of volcanology, International Union of Geodesy and Geophysics, on September 22, 1936 (*Bull. volcanologique*, 3, Series 2, Naples, 1938). The author is concerned to make out a case for a system of surface layers on the earth such as will be consistent with the petrological make-up of such layers, which he considers necessary for the explanation of past and present volcanic activity. The data used are in part derived from the study of actual individual earthquakes, and partly obtained from studies of the physical properties of rocks. The layer which transmits the P_g and S_g waves is considered to be 10–13 km. thick and to be petrologically similar to the Scottish Lewisian gneiss. Two sets of P^* and S^* waves are considered possible, necessitating a division of the 'intermediate layer' into an upper one of tholeiitic basalt similar to the Whin Sill, and a lower one consisting of olivine basalt. The two together are considered to be about 25 km. thick. The author admits that the subdivision is still in the hypothetical stage. Sparks's paper has been further discussed by Stoneley (NATURE, November 5, p. 840). The underlying material, down to a depth of 480 km., which transmits the P_n and S_n pulses, is suggested to consist of dunite, peridotite or eclogite.

Oxides of Bromine

IN 1937, Schwarz and Schmeisser reported the discovery of bromine dioxide, BrO_2, which they prepared by passing the silent electric discharge between aluminium electrodes through a mixture of bromine and oxygen in the proportion of one part to five. The oxide was described as an egg-yellow solid. It has now been further investigated by Schwarz and Wiele (*Naturwiss.*, **26**, 742; 1938). When heated, not only does it decompose to some extent into its elements, but also it gives rise to a white compound, apparently a higher oxide of bromine, either Br_2O_7 or Br_2O_8, and a dark-brown oxide, Br_3O (about 20 per cent of the yield). The latter was isolated in the pure form. It is no doubt identical with the compound obtained by Brenschede and Schumacher in 1936, but these workers obtained it with excess of bromine in carbon tetrachloride solution, and determined its formula by investigation of its absorption spectrum, and from lowering of the freezing point. The substance now obtained in the pure form dissolves in carbon tetrachloride with a strong green colour. Molecular weight determinations in solution indicate that the substance has the simple formula Br_3O. When allowed to act on carbon tetrachloride for a considerable time, the latter is oxidized to carbonyl chloride. It reacts smoothly with sodium hydroxide forming sodium hypobromite. Bromine monoxide has a powerful odour, reminiscent of hypochlorous acid. It is stable below — 40°, but gradually decomposes above this temperature. The rate of decomposition is not great, however, even at 0°.

No-Loss Dimmers for Small Cinemas

IN the *Siemens Review* (**14**, (3), 146; 1938) published in Berlin, a description is given of new apparatus for the gradual dimming of the lighting on the stage, in cinemas, concert halls, etc. The Siemens dimmer has the great advantage over the early resistance dimmers that the dimming of the lighting is practically unaccompanied by losses. At the last Leipzig Spring Fair a few of the smaller no-loss dimmers were exhibited of the types employed in amateur theatricals, small cinematic exhibitions, etc. There was shown a motor-driven circular dimmer with one regulating arm, and a two-arm dimmer with sheaves for hand operation from a control stand. The rated load for one arm at 220 volts is up to 4,400 watts and for two arms it goes up to 5,500 watts. Within these limits any number of lamps can be connected, without in any way affecting the degree of the efficiency of the dimming. For larger installations comprising more than two circuits, it is customary to use 'Siemens-Bordoni' dimmers. If the supply is single phase, sixteen circuits can be connected and if three phase fifty-four circuits. The Bordoni dimmer shown at the Fair was arranged for four circuits, and equipped with four regulating slides, with corresponding driving frame. The two circular dimmers were connected up for demonstration purposes to a part of the stand lighting, the corresponding reduction in the current consumption being rendered visible to the visitors by the readings on a wattmeter.

Wave Geometry

EARLIER investigations on this subject by a group of workers at the Hirosima University, Japan, have already been mentioned in NATURE (Dec. 21, 1935, and May 22, 1937). Previous notices dealt with fifteen papers. Since that time no fewer than eighteen more have appeared. The first twenty-five papers have now been reprinted and published under the title of "Collected Papers on Wave Geometry" (Tokyo, Tyūbun-Kan, 1938). One of the most interesting is No. 22, by K. Morinaga, "The Hydrogen Atom in Terms of Wave Geometry". At first sight, the work appears to be quite different from the usual relativity of quantum treatment, but the final results agree closely with those of Schwarzschild, de Sitter, Schrödinger, and Dirac. However, there is one difference in the physical interpretation. Although the ψ of the wave geometry equation has the same mathematical properties as that of the same symbol in Dirac's work, the former is associated mainly with the nucleus, but the latter with the electron. Paper 24, by T. Iwatsuki, Y. Mimura and K. Morinaga, and Paper 25, by T. Sibata, deal with Born's new field theory. In the original form of this theory, various difficulties arise, and to deal with these what appear to be rather arbitrary assumptions are made. It is shown that Born's theory can be regarded as a form of wave geometry, and that in consequence there is a natural and obvious method of overcoming the difficulties referred to. As for the later papers, several of interest are contained in the *Journal of Science of the Hirosima University* (**8**; 1938). In Paper 31, K. Itimaru shows that the red shift of the spectral lines of the nebulæ and the Hubble velocity-distance relation can be deduced from wave geometry. The wave geometry form of cosmological theory is nearly the same as de Sitter's, with one fundamental difference. It is consistent with the existence of finite concentrations of matter, and so accords with the actual universe.

Annual Meeting of the Royal Society

Awards of Medals*

Copley Medal: Prof. Niels Bohr, For. Mem. R.S.

Prof. N. Bohr has been for many years the recognized leader of theoretical atomic physics. His early work in 1913 provided the connecting link between Planck's conception of quanta and Rutherford's of the nucleus, and made it possible for the first time to constitute a consistent theory of spectroscopy. The development of this theory owes nearly as much to Bohr as did its inception. Among other things, he invented the principle of correspondence, according to which quantum phenomena pass over into the classical as a limiting case, following certain definite rules which Bohr laid down. This principle was of the greatest importance in the early days of the theory.

Besides providing a rational explanation of atomic spectra, Bohr's theory made it possible to give a satisfactory explanation of the structure of atoms, and in particular to explain the changes in properties which occur as we go from one element to the next in Mendeléeff's Periodic Table. In doing so it provided an explanation of the shells of electrons proposed by J. J. Thomson. In the development of this theory Bohr's mathematical ingenuity and his application of the theory of perturbation played a large part.

When the principles of wave mechanics were initiated by de Broglie and Heisenberg, the latter of whom was a pupil of Bohr's, Bohr took an important part in the development of the new ideas, and in transforming atomic theory to fit them. The view which is held at the present day of the relationship between waves and particles is very largely due to Bohr.

In the last few years, Bohr has transformed the ideas held as to the structure of the nucleus by pointing out the intimate association of the particles which comprise it, and the necessity for treating them as part of a closely knit system more like a liquid than a gas. This fundamental idea has already had far-reaching effects, and is the basis of almost all present work.

Although his published papers are of supreme importance, it is probable that Bohr's greatest contribution to physics lies in the influence which he has exerted over an enormous proportion of the leading physicists of the world.

Rumford Medal: Prof. R. W. Wood, For. Mem. R.S.

The study of physical optics owes much to Prof. Wood, who has been one of the leading experimenters in this field for the past forty years. Before the advent of Bohr's quantum theory, when our knowledge of the structure of atoms and molecules was very meagre, Wood had discovered the line and continuous absorption of sodium vapour, the phenomenon of resonance radiation of gases and vapours, and the quenching of this radiation by foreign gases. These discoveries opened up rich fields of research and were of the greatest value to later workers in laying the foundations of the theory of atomic and molecular spectra.

The elucidation of the phenomenon of resonance radiation demanded the utmost experimental skill and resource. Nothing less powerful than an improvised 40 ft. focus spectrograph sufficed for his work on the remarkable resonance spectra of molecules. In addition to his researches on the resonance radiation of metallic and other vapours, Wood investigated their magnetic rotation and dispersion. More recent but belonging to the same domain of experiment are the very interesting discoveries of Wood and Ellett on the magneto-optics of resonance radiation.

Wood's mastery of technique is universally acknowledged. He has introduced many ingenious and striking devices to experimental method. These are too numerous to catalogue here, but special mention must be made of his method of the production of atomic hydrogen and his observations on the spontaneous incandescence of substances in atomic hydrogen, which led to the invention of the atomic hydrogen welding torch by Langmuir; his very efficient and now widely used method of observing Raman spectra; his échelette grating which has proved to be the grating *par excellence* for the investigation of the near and far infra-red; and his pioneer use of light filters in ultra-violet and infra-red photography.

A Royal Medal: Dr. F. W. Aston, F.R.S.

Few cases are known to science in which an important development has remained so much in one man's hands as has the study of isotopes, by means of the mass-spectrograph, in those of Dr. Aston. Aston's attention was directed to isotopes by his work as assistant to Sir J. Thomson when the latter was working on the analysis of positive rays by the parabola method. The results for neon suggested very clearly that this element contained atoms of weight 20 and 22; but other explanations were conceivable.

After the Great War, by means of his mass-spectrograph, Aston showed that the lighter constituent of neon had a mass less than corresponded to the density of the gas as a whole, which was therefore a mixture. But the results went much further, and Aston found that not neon alone but also the majority of elements consisted of mixture of isotopes, in the sense already established by Soddy and others for certain products of radioactivity. This discovery profoundly altered men's views as to the nature of the ordinary chemical elements. For one thing, atomic weights as ordinarily determined were seen to be merely weighted means and not fundamental constants. By various modifications of this method Aston was able to extend his experiments to cover the great majority of the known elements, and to establish the existence of hundreds of isotopes. In addition, he was able to show that, with the exception

*From the remarks made by Sir William Bragg, Pres. R.S., in making the presentations.

of hydrogen, all the isotopes had nearly integral atomic weights taking oxygen as 16. This result was of great importance in connexion with Rutherford's theory of the nucleus.

The later developments of Aston's work are concerned mainly with the small deviations from this whole number law. Since on the theory of relativity mass and energy are equivalent, the mass of a nucleus is a measure of its internal energy, and the small divergencies from whole numbers give the energy with which the constituent particles are bound together. Using an improved mass-spectrograph capable of an accuracy of 1 in 20,000, Aston has determined this binding energy with considerable accuracy, at least for the lighter elements.

By determining photometrically the proportions of the isotopes Aston has been able to calculate 'chemical' atomic weights, which in some cases have corrected those found by the older methods. Thus both in chemistry and in physics Aston's work has been of outstanding value.

A Royal Medal: Prof. R. A. Fisher, F.R.S.

Prof. R. A. Fisher's contributions, both to the development of the logical theory of statistical methods and to the invention of efficient tools for the use of the experimental worker, have been of outstanding importance. Before Fisher entered the field (in 1912), the work of Galton, Pearson and their immediate pupils had widely extended the connotation of statistical methods, particularly in biological research. Useful descriptive methods had been invented, and reasonably adequate tests of sampling errors when samples were large (say, a hundred or more observations) were made available. As a result, there was an enormous increase in the number of workers who applied quantitative methods to biological, medical and sociological problems.

It may be said that in freeing the statistical methods of weaknesses obvious a quarter of a century ago, Fisher has been one of the chief contributors to the improvement of the logical basis of statistical methodology. He has been the most important contributor both to the theory and practice of small sample analysis, and to the armamentarium of statistical tools for biological and technological research. His own practical contributions to the study of genetics have been neither few nor unimportant, but the scope of his work has covered a much wider field of scientific research concerning both the physical and biological sides.

Davy Medal: Prof. G. Barger, F.R.S.

Prof. G. Barger's two most important contributions to knowledge are linked together, namely, his work on the alkaloids of ergot and on the sympathomimetic amines. After his isolation (with Carr) of the alkaloid ergotoxine, to which the effect of ergot on the cock's comb is due, he showed that the pressor bases from putrid meat were the products of decarboxylation of amino-acids, and included *p*-hydroxyphenylethylamine, derived in this way from tyrosine. He worked out methods for the synthesis of *p*-hydroxyphenylethylamine and allied compounds, and proved that this compound and also histamine, the product of decarboxylation of histidine, occurred in extracts of ergot.

One of the earliest systematic investigations of the relation between chemical constitution and pharmacological properties was the work which Barger carried out in collaboration with Dale on the sympathomimetic amines of the phenylethylamine class. He has made considerable contributions to our knowledge of the constitution of many alkaloids, and also of many naturally occurring derivatives of amino-acids. Special mention may be made of his work, carried out jointly with Harington, on the constitution and synthesis of thyroxine.

Darwin Medal: Prof. F. O. Bower, F.R.S.

Prof. F. O. Bower's main contributions to botany have been the intensive study of the morphology and affinities of ferns and allied plants. A series of papers on the development of spore-bearing organs in the Pteridophyta is a contribution to phylogeny of great importance. In his book "Origin of a Land Flora" (1908) Bower discussed evolutionary problems with special reference to the Bryophyta and Pteridophyta; twenty-six years later he dealt with the same problem in "Primitive Land Plants". His three volumes on ferns (1923–28) are a classic work on the affinities of members of this group and a most valuable source of information. In 1930 he discussed "Size and Form in Plants". Prof. Bower has consistently devoted himself to a branch of botanical science in which he has long been regarded as a leading authority. By his own researches and the judicial examination of recorded facts he has thrown light on the natural affinities of certain groups of plants.

Hughes Medal: Dr. J. D. Cockcroft, F.R.S., and Dr. E. T. S. Walton

The discovery by Dr. J. D. Cockcroft and Dr. E. T. S. Walton that the transmutation of elements can be effected by means of artificially accelerated particles has opened up a new line of work of outstanding interest and importance. In previous experiments, initiated by Rutherford so long ago as 1919, the transmutation of several elements had been produced by bombarding them with the α-particles from the natural radioactive substances. In this early work it was thought that bombarding particles of very great energy were required to disrupt atomic nuclei. The development of quantum mechanical ideas to nuclear problems made it possible for the first time to see how charged particles of low energy could penetrate into an atomic nucleus, and, moreover, enabled calculations to be made of the probability of penetration.

It was on the basis of such calculations that Cockcroft and Walton came to the conclusion that protons accelerated by moderate potentials, of the order of a few hundred kilovolts, should be able to effect the disintegration of the lighter elements. During 1930 attempts were made to disintegrate lithium by bombardment with protons using accelerating voltages up to 300,000 v. The results were at first negative, but continued experiment, in which the apparatus was re-designed to give voltages up to 600 kv., was in 1932 rewarded with the successful disintegration of lithium by bombardment with protons. Thus for the first time an atomic transmutation was effected by means entirely under the experimenter's control. These experiments of Cockcroft and Walton gave a tremendous impetus to investigations in nuclear physics.

Indian Archæological Investigation, Teaching, and Research*

THE mystery and fascination of Central Asia have been felt by three generations of travellers and scholars, and to-day we are blinded by treasures which a series of great excavations has given to the museums of Europe and Asia. It is in the museums and weighty reports of excavations that the historian must quarry for the raw material of history. The history of Central Asia has yet to be written; and for the most part we have to be content with brief and disconnected fragments, forming a background on which we must try to place the pieces of archæological evidence. The present expedition was undertaken in part with the object of directing attention to these problems, in part in the hope of providing a few fragments of evidence bearing on the great problem—that of chronology—in the study of the Buddhist art of Gandhara, the country which lay between the Indus and the Hindu Kush. The chronological scheme of Foucher, who wrote what still ranks as the standard work on Gandharan art, convenient and coherent as it is, is purely stylistic, and does not meet the requirements of the archæologist and historian, as had been demonstrated by the archæological investigations at Hadda of the French delegation, which has been at work in Afghanistan since 1922. Evidence of the influence of Gandharan art has come from various central Asian sources, extending so far as Turfan in Chinese Turkestan; but there is one blank in the record—Bactria and the Oxus territory.

The present expedition beyond the Indian frontier spent the summer months of 1938 excavating in the valley of Swat, and later, on the invitation of the director of the French delegation, and with the permission and assistance of the Afghan Government, in an archæological reconnaissance of the archæologically unexplored territory in the north of Afghanistan, covering a distance of two thousand miles.

In the Swat valley, Barikot was made the first camping site of the expedition in order to excavate some of the monastic and domestic sites in the three side valleys, which converge at this point. In the course of the two months which were spent here, a complete survey was made of all the Buddhist ruins, and a map was prepared showing not only the remains of stupas, monasteries and fortresses, but also of those of their dependent villages and terraced cultivations, with the view of determining the areas of settlement and the relations between domestic remains and areas of cultivation—in fact, to see what this small area looked like in Buddhist times. It was also hoped to determine the relation between specific pieces of sculpture and such domestic objects as might help, because of their appearance elsewhere in dateable contexts, to establish a chronology of Gandharan art.

Khanjar Khote, a typical monastic site, and one of a number excavated, consisted of a main courtyard, in which a stupa stands, surrounded by small stupas, following no fixed plan. They were evidently built by different donors and probably at different times. Behind is another courtyard, and cells for monks, some of which probably became niches in which a Buddha was set up, aligned along a road and at higher levels built in the hillside. The harvest from the small stupas was not rich—a number of pieces of blue schist showing scenes from Buddha's life in relief, two or three plaster heads, carved bases of model stupas and innumerable pieces of broken decoration. Amluk, a solitary site on a mountain top, was a more interesting place. Here the masonry was of unfamiliar pattern and the harvest richer. Hence came a 3 ft. seated Buddha of Foucher's 'late' variety. The circumstances in which the sculptures were found suggests destruction by Mohammedan invaders rather then the slow decay of which Huien Tsiang speaks.

Two members of the party excavated an acropolis 120 ft. high and covered with potsherds at Charbagh in Upper Swat, but with disappointing results. Some terra-cotta animal figures and one human torso may prove of value; but owing to the conservatism of the Indian potter, it is probable that we shall never achieve an intelligible chronology, or even classification of types of pottery, such as the European archæologist is accustomed to use as his guide.

Until the plaster heads have been compared with those from Takht-i-Bahi and Hadda, until seals, pottery, and iron objects have been studied, and corroded coins have been cleaned and deciphered, it cannot be said how much nearer this summer's work has brought us to an archæological, as distinct from a stylistic, chronology of Greco-Buddhist art, or whether any contribution has been made to the solution of another problem—why such a virile hybrid art sprang up in a comparatively small area on the Indian frontier and spread to Afghanistan and Chinese Turkestan. The main type of the Swat Buddha, however, has been established. He is squat and expressionless, with an Indian face. The Boddhisatva is not a saint, but an Indian prince in Greek dress.

At the end of July, two members of the party, the leader and one other, left for Kabul, and starting thence crossed the Hindu Kush into the Oxus plain, where a large number of the mounds with which Bactria is covered were examined and measured. At Kunduz, twenty-five miles south of the Oxus, there are a number of mounds and an impressive 'round' castle, with mud walls more than a hundred feet high and half a mile in circumference. It may be one of the centres by which the Sassanid kings kept their precarious hold on Bactria. On one site here a find was made which may be of importance—carved bases of Greek columns, which disprove the contention of M. Foucher, that the Hellenistic cities of Bactria were built of mud and sun-dried brick.

In the preparations for this expedition, although the keeper of the India Museum, London, and others were of the greatest assistance, the lack of a centre for Indian archæological studies in London, it was stated, had proved a grave handicap. Unless such expeditions as this are to be nothing more than a flash in the pan, if British work in India is to have a long-term programme, something more substantial is required than the occasional enterprise of one or

* Abstract of a lecture on "The Results of the Recent Archæological Expedition to Swat and Afghanistan in Relation to the Present Position of Indian Studies in this Country", by Evert Barger, lecturer in medieval history in the University of Bristol, delivered before the Royal Society of Arts on November 30.

two individuals. There must be a permanent centre in London for teaching and research, which would be a base for such expeditions, and for the study of the material they bring back. It is obvious that the personnel of expeditions should not be recruited in haphazard fashion from persons with few qualifications. There should be a team of specialists, engaged in teaching and research, who could be drawn upon for expedition work from time to time as occasion offered. It is sad to think that, at a time when India is much in our minds, at a time when our relations with her have reached a turning point in history, and she stands at the brink of a great experiment, there should be no professional home in London for the study and appreciation of Indian history and culture. Though there is still some doubt as to the function of a museum, those who know what the present keeper has done for the India Museum—a place where the student can now study each of its civilizations as a whole and in all its aspects—would agree that if there is to be a centre for teaching and research and a base for future expeditions, it can only be the India Museum.

A discussion followed the lecture (see p. 1029).

The Future of Gaseous Fuel

THE town's gas industry is now well advanced into its second century of activity, although during the last half century it has, from time to time, been considered by observers as doomed to supersession sooner or later by other methods of using coal. Such opinions, based as they were on superficial knowledge, were always unwarranted, as revealed by the fact of steady growth of the use of gaseous fuel and the number of its applications. This growth has accompanied an increase in the efficiency of appliances. The present position and future of the industry have been the subject of several addresses in recent months.

Some time ago, Mr. E. V. Evans read a paper to the Royal Society of Arts on the importance of coal carbonization in the life of the nation, emphasizing the range and indispensability of its products. The modern tendency to avoid arduous and dirty tasks of domestic routine promotes the expansion of the use of gaseous fuel, which need not be stored and lends itself to automatic control. The same tendency is seen in many industrial heating operations, in spite of systems of charging which often do not encourage the free use of gas. It is only since 1920 that the sale of gas has been based on the heating value, and even now freedom to base sales on a rational system of charging is not complete. On this depends the expansion of use for large-scale operations.

Sir Harold Hartley, in his presidential address to the Society of British Gas Industries, said that the strength and vitality of an industry depends on the way it uses the resources of science. Research is the best insurance of its future, he said, and he referred to what the application of science has done to maintain and promote development of the use of gaseous fuel. The range and extent of this was given in very specific terms in a recent address of Sir David Milne Watson to the Fuel Luncheon Club, when he said that his own company—the Gas Light and Coke Co.—incurs annually an expenditure exceeding £100,000 on its research activities. In them all types of scientific skill are brought to bear on the problem of gas manufacture and purification, and utilization, including the handling of by-products.

Mr. Evans, looking to the future, envisaged the possibility of producing gas without coke—something which a very large increase in the use of gaseous fuel might render urgently necessary. Already the industry has initiated research on the gasification of coal under pressure. The possibility of securing far-reaching gasification and the production of large yields of methane and primary tars is already foreshadowed. If the early promise already shown is followed by economic success, the distribution of fuel in gaseous form will receive a great impetus. While these developments are proceeding, it will be interesting to watch the progress of the experiments made by the Soviet Union on the underground gasification of coal. Following on experiments, it is reported by the Russia Today Press Service that a commercial plant commenced operation in Gorlovka in 1937. Others are projected—one to supply Moscow—and claims are made for the cheapness of the gas.

H. J. H.

University Events

CAMBRIDGE.—C. B. Davies, of Trinity Hall, has been appointed for the present academical year to the studentship offered by Imperial Chemical Industries, Ltd.

The degree of Master of Arts has been conferred upon Dr. A. J. Bradley, assistant director of research in crystallography.

Sir Edward Mellanby, secretary of the Medical Research Council, has been appointed Rede lecturer for the year 1939.

The following appointments in the Museum of Zoology have been made: F. T. Parrington, of Sidney Sussex College, to be director; H. B. Cott, of Selwyn College, to be curator of vertebrates, and Strickland curator; J. E. Smith, to be curator of invertebrates; Dr. G. C. Varley, of Sidney Sussex College, to be curator of insects. Dr. Varley has also been appointed University demonstrator in zoology.

The British Electrical and Allied Industries Research Association and the Permanent Magnet Association have offered to make jointly a grant of £550 a year to the University for the purpose of supporting research on magnetic materials under the direction of Prof. W. L. Bragg; and the Iron and Steel Industrial Research Council has offered to the University a grant at the rate of £500 a year for research on the structure of alloys, to be carried out in the Cavendish Laboratory under the same direction. In both cases, the grants will provide for the continuation of investigations which have been in progress for some time under Prof. Bragg's direction, first at the University of Manchester and afterwards at the National Physical Laboratory.

LONDON.—The title of professor emeritus of embryology in the University has been conferred on Prof. J. P. Hill, on his retirement from the University chair of embryology at University College, and that of professor emeritus of chemistry in the University on Prof. Samuel Smiles, on his retirement from the Daniell chair of chemistry at King's College.

Science News a Century Ago

New or Rare Plants in Edinburgh

ON December 10, 1838, Robert Graham, professor of botany, sent to the *Edinburgh Philosophical Journal* a "Description of several New or Rare Plants which have lately flowered in the Neighbourhood of Edinburgh". The *Chorizema Dicksonii*, he said, was raised by Dickson and Sons from seed sent from Swan River, Australia; the *Collinsia heterophylla*, the handsomest species of *Collinsia* yet known, was found by Nuttall on the Columbia and was raised at the experimental garden from seeds sent from America; the *Edwardsia Macnabiana* had been cultivated in Edinburgh for some years but it was not known whence it came, and the *Mirbelia augustifolia*, though apparently a distinct species, but without beauty, was raised from seed from New Holland.

Littrow's Observations of Meteors

THE *Athenæum* of December 15, 1838, reprinted from the *Vienna Official Gazette* a note by Karl von Littrow on "Falling Stars in August and November". "The phenomena," said von Littrow, "of an extraordinary abundance of falling stars, about the middle of November, has been again observed this year. . . . On the 10th of November when we watched from eight in the evening till one in the morning, we counted about nine such stars in an hour. . . . On the 11th of November . . . we counted about twenty in an hour. . . . On the 13th of November the sky suddenly cleared up an half an hour before midnight and remained perfectly serene till daybreak. During those six hours we noted 1002 falling stars." Von Littrow then went on to refer to the observations made in August.

Karl Ludwig von Littrow (1811–77) was the son of Joseph Johann von Littrow (1781–1840) who from 1821 until his death was professor of astronomy and director of the observatory at Vienna. In 1826–27, the latter erected an observatory in the middle of the city on the site of that founded by Father Maximilian Hell in 1753. Karl von Littrow became an assistant under his father in 1831, succeeded to the directorship in 1842, and it was during his period of office that in 1874–77 the modern observatory was built. Newcomb, in "The Reminiscences of an Astronomer" tells how through colour-blindness von Littrow had been led to wrong conclusions regarding alterations in the manuscript notes made by Father Hell of the transit of Venus of 1769.

Brickmaking by Machinery

THE *Mechanics' Magazine* of December 15, 1838, contained a note on Jones's "Machinery for Moulding Bricks". "The earth," it said, "in its descent, is forced into the moulds by great pressure as they pass under the Pug-Mill, and is delivered therefrom in perfect bricks upon pallet-boards ready to be removed, the whole of which is done by the horse attached in the usual way to the Pug-Mill producing from 1,000 to 2,000 bricks an hour. The earth also being moulded with only one half the usual quantity of water will take considerably less time to dry. A machine was at work last week on three successive days at Messrs. Webb's brickfield, near Ball's Pond Church, Islington, and performed the work admirably."

Societies and Academies

London

Royal Society (*Proc.*, A, **168**, 441–589; 1938).

R. M. LEWIS and C. N. HINSHELWOOD: The thermal decomposition of nitrous oxide.

B. F. J. SCHONLAND, D. J. MALAN and H. COLLENS: Progressive lightning (6).

H. A. JAHN: A new Coriolis perturbation in the methane spectrum. (1) Vibrational-rotational Hamiltonian and wave functions. (2) Energy levels.

N. ARLEY: On the theory of coincidence experiments on cosmic rays.

R. EISENSCHITZ: The specific heat of β-brass.

N. FEATHER and J. V. DUNWORTH: A further study of the problem of nuclear isomerism: the application of the method of coincidence counting to the investigation of the γ-rays emitted by uranium Z and the radioactive silver Ag^{106}.

Paris

Academy of Sciences (*C.R.*, **207**, 881–948, Nov. 14, 1938).

L. CAYEUX: The problem of the ancient port of Tyre, studied in the light of petrography. Petrographic examination of material brought up from the roadstead confirms the results of air- and other photographs that the ancients were able to undertake submarine construction.

A. CHEVALIER: Improvement in the production and quality of French colonial coffees.

G. CALUGARÉANO: Invariants of extension of regular *fonctions analytiques à l'infini*.

L. HIBBERT: Curves of equal modulus of *fonctions entières*.

L. REINGOLD: Calculation of the theoretical mean combustion temperature and the corresponding pressure.

D. BARBIER, D. CHALONGE, F. SCHAHMANÈCHE and MLLE. N. MORGULEFF: The Balmer discontinuity in the spectrum of supergiant stars of types *B*, *A*, *F*.

V. FROLOW: Mareographs of the United States: facts and hypotheses.

R. LUCAS: Thermal expansion of liquids.

L. QUEVRON: An integrator of radiant energy.

P. BARCHEWITZ and M. PARODI: Absorption spectra of mono-substituents of benzene in the distant infra-red, from 180 to 600 $cm.^{-1}$ (17–55 μ).

M. SERVIGNE: Infra-red emission in the luminescence of some rare elements. Substances in solid solution in calcium tungstate have been examined.

P. AUGER: Study of large cosmic ray showers at an altitude of 3,500 m. They behave as showers caused after their entry into the atmosphere by electrons of energy exceeding 10^{13} ev. and containing a component capable of traversing more than 10 cm. of lead.

J. SOLOMON: Statistical theory of nuclei.

V. DOLEJŠEK, J. BAČKOVSKÝ and J. FAUS: Hyperfine structure of X-rays.

R. AUDUBERT: Application of the Debye-Hückel theory to the estimation of a solution of mastic.

H. MOUREU and G. WETROFF: Formation and polymerization of the radical phosphonitrile, PN.

M. TIFFENEAU and MLLE. B. TCHOUBAR: Action of magnesium halides in the state of etherates on aliphatic, aromatic and cyclic 'oxides'.

Y. DEUX : Isomerization of the oxide of dimethyl-vinylethylene to dimethyl-2-2-butene-3-al : migration of the vinyl radical.

J. HOCH : Substances showing a female sex hormone effect ; synthesis of two oxocyclopenteno-1,2-phenanthrenes.

A. MEYER and H. DRUTEL : Formation of colouring matters of the isocyanine group by intermolecular condensation of 4-chloroquinaldines.

G. VAVON and P. MONTHÉARD : Velocity of formation of oximes, phenylhydrazones and semi-carbazones of the phenol aldehydes.

A. BERSIER : Eolian traces of the pre-Molassian in the primary sediments of the Swiss Molasse.

J. LEGRAND : Causes of the long-period oscillations of the mean annual sea-level at Brest and on the coasts of the North Sea.

MLLE. A. PÉREAU : Annual component of the levels of the Nile.

L. BERTHOIS : Influence of currents on marine deposits.

M. CHADEFAUD : Pyrenoids of Algæ.

R. FONTAINE, R. GUILLEMET, P. MANDEL and P. BRANZEU : Aspects of nitrogen consumption in experimental intestinal occlusion in the dog.

ACH. URBAIN, R. CAHEN, MLLE. M. A. PASQUIER and J. NOUVEL : Action of zinc on the effects of testosterone and of prolans. Zinc increases the gonadotropic effect of these substances.

J. CHAUSSIN and L. LESCŒUR : Physico-chemical study of the nychthemerous fraction of the urinary elimination in a diabetic.

R. ENGELAND and A. BASTIAN : Contribution to our knowledge of elastoidine.

J. ROCHE and MLLE. E. BULLINGER : Phosphatases of the osseous system of fishes (selachians and teleosteans). All the bones, teeth and scales examined contained phosphomonoesterase A_1 identical with that of the skeleton of mammals and birds. The permanence of the cartilaginous skeleton of selachians is not due to absence of this phosphatase but to its mode of distribution.

Amsterdam

Royal Netherlands Academy (*Proc.*, **41**, No. 8, 1938).

E. COHEN and W. A. T. COHEN-DE MEESTER : Acute tin plague (3). Extremely small amounts of magnesium added to purest tin produce acute tin plague, that is, greatly increase the rate of transformation of white into grey tin. Traces of bismuth have the opposite effect.

W. VAN DER WOUDE and J. J. DRONKERS : Rectilinear congruences in the three-dimensional projective space built up of quadratic reguli.

H. WARREN, D. KUENEN and L. G. M. BAAS BECKING : On the relation between internal and external media in *Artemia salina* (L.) var. *principalis* Simon. The NaCl content of the blood of this phyllopod can account quantitatively for its osmotic properties, and there are indications that regulation is effected by means of excretion or uptake of water.

C. S. MEYER : Contributions to the theory of Whittaker functions (3).

A. F. MONNA : Theory of curves in Hilbert space.

W. F. H. M. MOMMAERTS : Some chemical properties of the plastid-granum. In the phyllochlorin of a grana-suspension the ratio protein units to porphin nuclei is 1 : 1 as is the case in other conjugated proteins of great biochemical importance.

M. F. E. NICOLAI and C. WEURMAN : Some properties of chlorophyll-multifilms. A study of Langmuir-Blodgett films formed by spreading chlorophyll on protein or lecithin layers.

F. C. BURSCH, F. FLORSCHÜTZ and I. M. VAN DER VLERK : An early palæolithic site on the Northern Veluwe (Holland). The artefacts found near Wezep and the geological and archæological evidence of their age.

A. N. BURKITT : External morphology of the brain of *Notoryctes typhlops*.

Cracow

Polish Academy of Sciences and Letters (*C.R.*, Oct. 3, 1938).

TH. BANACHIEWICZ : Method of numerical resolution of linear equations, of the calculus of determinants, of the inverses and of the reduction of quadratic forms.

M. WIERZBICKI : Dielectric constants of some univalent electrolytes at different temperatures.

K. DZIEWOŃSKI, T. CHOMIK and M. KSIĄŻEK : Compounds derived from α, β-dinaphtho-γ-pyrone.

K. DZIEWOŃSKI and E. CHOLEWA : Syntheses of compounds of the type of 2′-phenyl-3′,4′,2,3-quinolino-quinoline.

SZARSKI : Vascularization of the thymus in some Urodeles.

(*C.R.*, Nov. 7, 1938).

TH. BANACHIEWICZ : Chio's law, Cracovians and matrices.

T. NAYDER and T. PIECH : Refraction and dispersion of liquid phosphorus.

S. DOBIŃSKI and A. JAGIELSKI : Adsorption in the solid state. In certain alloys, the components with lowest superficial pressure condense on the surface.

E. KURZYNIEC : Variation of the electric resistance at low temperatures of (1) alloys of tin and zinc, (2) alloys of lead and antimony. At the temperature of liquid hydrogen and liquid nitrogen, the ratio R_t/R_0 increases rapidly with increase of zinc, reaching a maximum at 1–2 atomic per cent of zinc, and then decreases almost linearly to the value for pure zinc. For lead-antimony alloys, the ratio increases rapidly for minute additions of lead.

M. BLUMENTHAL : Action of water vapour on amalgamated aluminium. A crystalline modification of aluminium hydroxide is obtained. The reaction can be explained by the theory of adsorption and active centres.

M. BLUMENTHAL and Z. SOTIROW : Thermal dissociation of cerium carbonate.

S. KULCZYŃSKI : Peat-bogs of Polesia. Eighteen types are differentiated by their floristic, hydrological and biological characteristics.

T. A. BOCHEŃSKI : Frutification cones of Sigillarians and their mode of insertion on the trunks. The cones of the 'oil' fossils studied carry either megaspores (1·6 mm. diameter) or microspores (0·05 mm. diameter), but not both.

GRODZIŃSKI : Cytological researches on the yolk of chicken's egg under normal and experimental conditions.

Forthcoming Events

[*Meeting marked with an asterisk is open to the public.*]

Monday, December 12

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Dr. Hugh Scott: "A Journey to the Yemen".

Tuesday, December 13

ROYAL ANTHROPOLOGICAL INSTITUTE (in the rooms of the Royal Society), at 8.30.—Dr. D. F. Thomson: "Survey of Arnhem Land".

PHARMACEUTICAL SOCIETY (at 17 Bloomsbury Square, London, W.C.1), at 8.30.—W. G. Templeman: "Plant Growth Hormones and their Uses", illustrated by lantern slides.

CHADWICK PUBLIC LECTURE (at the London School of Hygiene and Tropical Medicine), at 5.30.—Leonard Colebrook: "The Control of Puerperal Fever".*

Wednesday, December 14

INSTITUTION OF CIVIL ENGINEERS, at 6.30.—W. A. Tookey: "Dugald Clerk and the Gas-Engine: his Life and Work" (Dugald Clerk Lecture. Students' meeting).

Thursday, December 15

ROYAL METEOROLOGICAL SOCIETY (at the Gaumont British Theatre, Film House, Wardour Street, W.1), at 5.—Sound films: "Fog" and "Ice Formation", to be followed by discussion.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Humphry Rolleston: "The Early History of Morbid Anatomy" (Thomas Vicary Lecture).

LONDON MATHEMATICAL SOCIETY (at the Royal Society, Burlington House, Piccadilly, W.1), at 5.—Dr. D. H. Lehmer: "The Computational Side of the Theory of Numbers".

CHEMICAL SOCIETY (at the Royal Institution), at 6.—Dr. Irving Langmuir, For.Mem.R.S.: "Monolayers on Solids" (Faraday Lecture).

Friday, December 16

SOCIETY OF CHEMICAL INDUSTRY (LIVERPOOL SECTION), at 6.—W. A. S. Calder: "Why a Chemist?" (Hunter Memorial Lecture).

ROYAL INSTITUTION, at 9.—Dr. John Thomas: "Josiah Wedgwood and his Portraits of 18th Century Men of Science".

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

SCIENTIFIC OFFICER in the Chemical Defence Research Department of the War Department, 14 Grosvenor Gardens, S.W.1—The Chief Superintendent (December 12).

ASSISTANT (grade II) for library and publications work in the Building Research Station—The Establishment Officer, Department of Scientific and Industrial Research, 16 Old Queen Street, Westminster, S.W.1 (December 13).

SCIENTIFIC OFFICER (physics and/or mathematics) at the Royal Aircraft Establishment, South Farnborough, Hants—The Chief Superintendent. (Ref. 264 *O*. December 16).

ASSISTANT (grade II) in the Meteorological Office—The Under-Secretary of State (S.2.B. Met.), Air Ministry, Adastral House, Kingsway, W.C.2 (December 17).

RESEARCH CHEMIST in the Department of Clinical Investigation and Research, Manchester Royal Infirmary—The Director (December 23).

CHEMIST in the Admiralty Chemical Pool—The Secretary of the Admiralty (C.E. Branch) (quote Ref. C.E. 10493/38. December 23).

LECTURES IN BIOLOGY, GEOLOGY AND GEOGRAPHY, AND CHEMISTRY at the New England University College, Armidale, Australia—The Registrar, The University, Sydney (December 31).

SENIOR LECTURER IN MATHEMATICS in the Lester School and Henry Lester Institute of Technical Education, Shanghai—Messrs. Viney, Price and Goodyear, Empire House, St. Martin's-le-Grand, London, E.C.1 (January 12).

ASSISTANT IN THE INTELLIGENCE SECTION in the Mineral Resources Department of the Imperial Institute—The Establishment Officer.

Reports and other Publications

(not included in the monthly Books Supplement)

Great Britain and Ireland

North of Scotland College of Agriculture. Report on the Work of the North of Scotland College for the Year 1937–38. Pp. 42. (Aberdeen: North of Scotland College of Agriculture.) [1411

University College of North Wales. Calendar for Session 1938–39. Pp. 440. (Bangor: University College of North Wales.) [1611

Publications of the International Tin Research and Development Council. No. 80: Flux Inclusions in Hot-Dipped Tin Coatings. By Paul Rocquet. Pp. 10+4 plates. Free. No. 81: The Effect of Small Additions of Tellurium on the Mechanical Properties of Pure Tin. By Prof. D. Hanson and Dr. W. T. Pell-Walpole. Pp. 16. Free. (London: International Tin Research and Development Council.) [2111

Ministry of Agriculture and Fisheries. Agricultural Statistics, 1936. Vol. 71, Part 2: An Analysis of Agricultural Production, Prices and Supplies in England and Wales. Pp. ii+113–254. (London: H.M. Stationery Office.) 2s. 6d. net. [2111

Other Countries

Smithsonian Institution: Bureau of American Ethnology. Bulletin 119: Anthropological Papers. Pp. ix+204+12 plates. (Washington, D.C.: Government Printing Office.) 40 cents. [1211

Advisory Committee on Education. Staff Study No. 9: Vocational Rehabilitation of the Physically Disabled. By Lloyd E. Blauch. Pp. ix+101. (Washington, D.C.: Government Printing Office.) 15 cents. [1211

Svenska Hydrografisk-Biologiska Kommissionens Fyrskeppsundersökning. År 1934. Pp. 46. År 1935. Pp. 46. (Göteborg: Elanders Boktryckeri A.-B.) [1411

Meddelanden från Göteborgs Högskolas Oceanografiska Institution. 13: Measurements of Submarine Daylight. By Hans Pettersson and Horace H. Poole. With an Appendix: On the Standardisation of Photoelectric Cells by means of Sun Radiation, by Anders Angström. Pp. 34. (Göteborg: Elanders Boktryckeri A.-B.) [1411

Alcool motor e motores a explosão. Por Eduardo Sabino de Oliveira. Pp. 356. (Sao Paulo: Instituto de Technologia.) [1411

Advisory Committee on Education. Staff Study No. 15: Public Education in the District of Columbia. By Lloyd E. Blauch and J. Orin Powers. Pp. x+99. (Washington, D.C.: Government Printing Office.) 20 cents. [1611

U.S. Department of the Interior: Office of Education. Bulletin, 1938, No. 4: School Use of Visual Aids. By Cline M. Koon. Pp. viii+68. 10 cents. Bulletin, 1938, No. 8: The Elementary School Principalship; some Aspects of its Development and Status. By Bess Goodykoontz and Jessie A. Lane. Pp. v+43. 10 cents. Bulletin, 1938, No. 9: College Projects for Aiding Students. By Fred J. Kelly and Ella B. Ratcliffe. Pp. v+69. 10 cents. (Washington, D.C.: Government Printing Office.) [1611

University of California Publications in Zoology. Vol. 42, No. 3: The Pterylosis of the Falconiformes, with Special Attention to the Taxonomic Position of the Osprey. By Lawrence V. Compton. Pp. iii+173–212. 50 cents. Vol. 42, No. 5: Territory, Annual Cycle and Numbers in a Population of Wren-Tits (*Chamæa fasciata*). By Mary M. Erikson. Pp. iii+247–334+plates 9–14. 1.25 dollars. (Berkeley, Calif.: University of California Press; London: Cambridge University Press.) [1611

Proceedings of the United States National Museum. Vol. 86, No. 3041: Revision of the North American Beetles of the Staphylinid Subfamily Tachyporinæ. Part 2: Genus Coproporus Kraatz. By Richard E. Blackwelder. Pp. 10. (Washington, D.C.: Government Printing Office.) [1611

Journal of the Indian Institute of Science. Vol. 21A, Part 24: Hydrogenation of Oils by the Continuous Process. Part 2: Hydrogenation of Cottonseed and Olive Oils by Nickel Carbonate—Kieselguhr Catalyst. By V. T. Athavale and S. K. K. Jatkar. Pp. 285–294. (Bangalore: Indian Institute of Science.) 14 annas. [2111

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 168: Buckling of a Cage-form Cylinder under Axial Compression. By Katsutada Sezawa and Masami Murakami. Pp. 425–452. 45 sen. No. 169: On the Corrections to the Measured Take Off Run. By Hidemasa Kimura. Pp. 453–472. 35 sen. (Tôkyô: Kôgyô Tosho Kabushiki Kaisha.) [2111

Catalogues, etc.

Natural History Book Catalogue: Botany, Conchology, Entomology, Geology, Ornithology, etc. (No. 275). Pp. 44. (London: Dulau and Co., Ltd.)

Hormone Therapy. (No. 4.) Pp. 54. (London: Organon Laboratories.)

Zeiss Nachrichten. Holge 2, Heft 6, Juni 1938. Pp. 183–222. (Jena and London: Carl Zeiss.)

*p*H Values: What they Are and How to Determine Them. By T. Tusting Cocking. Fifth edition, revised and enlarged. Pp. 32. (London: The British Drug Houses, Ltd.)

Anthropology and Folklore, Archæology and Kindred Subjects, with a Section on Linguistics. (Catalogue No. 633.) Pp. 54. (London: Francis Edwards, Ltd.)

Bücher-Anzeiger Nr. 172. Pp. 64. (Leipzig: Gustav Fock, G.m.b.H.)

Catalogue of Optical Projection Apparatus. Part 2: Science and Colour Process Lanterns, Projection Microscopes, Polariscopes, etc. Pp. 24. (London: Newton and Co.)

Science and Medicine. (List 31.) Pp. 36. (London: E. P. Goldschmidt and Co., Ltd.)

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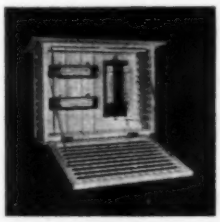

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OFFICIAL ANNOUNCEMENTS

WAR DEPARTMENT

STAFF FOR SCIENTIFIC RESEARCH

Applications for the undermentioned appointments are invited from adult male candidates having the qualifications set out below. Successful candidates would be posted in the first instance to the Explosives Directorate, Research Department, Woolwich, S.E.18.

For post 1 candidates should preferably be between the ages of 28 and 35, and for posts 2, 3 and 4 between 28 and 40; for posts 5 and 6 candidates must be under 35.

1. *Scientific Officers.* A first or second-class Honours Degree in Chemistry or Physics and at least four years' research experience in either a research laboratory or chemical manufacturing works. Experience of explosives or any manufacturing processes also calling for extreme care would be an advantage.

2. *Assistant Grade I.* A University Degree in Chemistry or Physics and considerable experience of chemical plant and manufacturing operations. Experience of explosives, etc. (as at 1 above), would be an advantage.

3. *Assistant Grade I.* A University Degree in Chemistry and considerable experience of industrial work; control of labour and of chemical plant, preferably in explosives industry.

4. *Assistant Grade I.* A University Degree in Chemistry and considerable experience in supervising inorganic and organic analyses carried out by subordinate staff. Experience of explosives or in works laboratories an advantage.

5. *Assistants Grade II.* A University Degree or its equivalent in Chemistry and experience in research either at a University or industrial establishment.

6. *Assistant Grade II.* A University Degree or its equivalent in Chemistry with Physics as a subsidiary subject and experience in an industrial or research establishment. Experience of indexing and making précis of technical reports desirable.

Salary Scales, etc.

Scientific Officer. £400 by £18 to £454, and thence by £25 to £680 a year. (Efficiency bar at £580.)

Exceptionally, a commencing salary up to £454 a year may be given to candidates with special qualifications and lengthy experience. The Federated Superannuation System for Universities will apply to these appointments.

Assistant I. £400 by £18 to £515 with extension in exceptional cases by £18 to £680.

Assistant II. £315 by £12 to £385.

Increments are granted annually, subject to approved service.

Promotion to higher grades and (in the case of Assistants) appointment to a pensionable post are governed by suitability and merit as and when vacancies arise.

Ex-members of H.M. Forces given preference, other things being equal.

Application should be made on a form to be obtained from the Chief Superintendent, Research Department, Woolwich, S.E.18, to be returned not later than December 23, 1938.

Candidates should quote the number of the post for which they are applying.

WAR DEPARTMENT

STAFF FOR SCIENTIFIC RESEARCH

Applications for the undermentioned appointments are invited from adult male candidates having the qualifications set out below. Selected candidates for appointments (1) and (3) would be posted in the first instance to the Chemical Defence Research Establishment, Sutton Oak, near St. Helen's, Lancs., and for appointment (2) either to that establishment or to the Chemical Defence Experimental Station, Porton.

(1) *Scientific Officers.*

A good Honours Degree or equivalent qualification in Chemistry together with some years' research and/or industrial experience in connection with chemical processes.

(2) *Junior Scientific Officers.*

Honours degree or equivalent qualification in Chemistry. One or two years' research experience desirable.

(3) *Assistants III.*

Preferably training up to University degree standard in Chemistry; Inter. B.Sc. or equivalent examination in Chemistry essential.

SALARY SCALES.

Scientific Officer. £400 by £18 annually to £454 and thence by £25 annually to £680 a year. (Efficiency bar at £580.) Exceptionally, a commencing salary up to £454 a year may be given to a candidate with special qualifications and experience. The Federated Superannuation System for Universities applies.

Junior Scientific Officer. £275 by £18 annually to £347 a year. After two years' probationary service the Federated Superannuation System for Universities applies.

The Junior Scientific Officer grade is of a probationary character, and during service in this grade an officer's suitability for continued employment and appointment to the grade of Scientific Officer is periodically reviewed. Within six years of the date of appointment, Junior Scientific Officers may normally expect to be promoted to Scientific Officer.

Assistant III. £130 by £12 annually to £310 a year. (Efficiency bar at £214.) Higher commencing salary up to £214 may be approved, according to age, qualifications and experience, and in this connection possession of a University degree will be taken into consideration.

Preference given to ex-members of H.M. Forces, other things being equal.

Application forms, obtainable by postcard from the Chief Superintendent, C.D.R.D., 14 Grosvenor Gardens, London, S.W.1, to be lodged with copies of not more than three recent testimonials by December 23, 1938.

WAR DEPARTMENT

CHEMISTS (Adult male) required for the Royal Ordnance Factory, Irvine, Ayrshire.

Candidates should preferably be under the age 35. They must possess an Honours Degree in Chemistry or equivalent qualification, and have had chemical manufacturing experience, preferably in connection with acids.

Annual Salary Scale. £275, rising by £18 annually to £455 and thence by £25 annually to £580 a year. (Efficiency bar at £455.) Exceptionally a starting rate up to £350 a year may be given to candidates with extensive experience.

The appointments are temporary.

Ex-members of H.M. Forces given preference, other things being equal.

Application forms obtainable by postcard from the Under-Secretary of State (C.5), The War Office, London, S.W.1, to be lodged not later than December 23, 1938. Quote Appts. 112.

AIR MINISTRY

Applications are invited for the undermentioned appointments at Air Ministry Headquarters, London, for technical and general administrative work in connection with the design, construction and development of aircraft.

B.70. Technical Officers.

Required for estimating performance and allied work, or to deal with matters arising from the design, development and Service use of aircraft.

Candidates for these posts should have had technical education to the standard of an engineering degree with several years' experience in the design, construction, and development of aircraft.

B.99. Assistants II.

To assist in the work of the Technical Officers detailed above.

Candidates for Assistant II posts should have had good technical education, with drawing office and works experience preferably upon aeroplane work.

Salary Scales.

Technical Officer.

£275×£18 to £455 by £25 to £580 a year, with an efficiency bar at £455 a year [women £275×£12—£347 (bar)×£18 to £464]. The commencing salaries will be up to £455 a year (men) and £347 (women) according to the qualifications and experience of selected candidates. Promotion to the higher grade of Senior Technical Officer (£680—£800 men, £580—£680 women) and above is governed by merit as and when vacancies arise.

Assistant II.

£315 by £12 to £385 a year (women £265 by £12 to £315). Promotion to the higher Grade of Assistant I(£400 to £515 men, £325 to £415 women) is governed by merit as and when vacancies arise. At the present time opportunities also exist for Assistants II to qualify for promotion to the grade of Technical Officer.

The appointments are non-pensionable but entrants will be eligible for consideration for pensionable posts in the event of vacancies arising on the permanent establishment.

Application should be made on a form to be obtained quoting the appropriate reference from the Under-Secretary of State, Air Ministry (S.2.D), Adastral House, Kingsway, London, W.C.2, to whom it should be returned without delay.

AIR MINISTRY

A large number of ASSISTANTS GRADES II AND III are required at the Royal Aircraft Establishment, South Farnborough, Hants. The scales of salary are:

A291. Assistant II: £315 by £12 to £385 a year (men); £265 by £12 to £315 a year (women).

A292. Assistant III: £130 a year (at age 19 by £12 a year to £310) (£260 women). There is an efficiency bar at £214. For candidates with suitable experience, and/or an education up to University degree standard the commencing salary may be £214 a year.

The qualifications required are:

(1) Good technical training, with workshops, drawing office or laboratory experience, or alternatively education to a degree standard.

(2) Experience in one or more of the following categories is necessary for Assistant II appointments and desirable but not essential for Assistants III.

(*a*) General Aerodynamics, including, if possible, wind tunnel, tank, or full scale observing experience.

(*b*) Practical metallurgical work on high grade engineering materials, including heat treatment and corrosion investigation.

(*c*) Experimental work on high speed internal combustion engines, components and accessories.

(*d*) Development work on radio communications equipment.

(*e*) Experimental work on small mechanical apparatus, chiefly instruments.

(*f*) Strength and aerodynamic calculations in aeroplane design.

(*g*) General engineering in the drawing office and workshops or laboratory. Experience of aircraft armament is desirable but not essential.

(*h*) Electrical illumination or electrical ignition equipment, or small electrical generators.

(*i*) Mechanical testing of materials and structures.

(*j*) Writing of technical descriptive matter relating to aircraft, aircraft equipment, or to aero engines and accessories.

Promotion from Assistant III to Assistant II, and from Assistant II to Assistant I (£400—£515) (£325—£415 women) is governed by merit as vacancies arise. Opportunities exist for Assistants II to qualify for promotion to Technical Officer (£275—£455—efficiency bar—£580 a year, men, and £275—£347—efficiency bar—£464 women). Candidates may be required to fly in aircraft as observers.

Application should be made on a form to be obtained from the Chief Superintendent, Royal Aircraft Establishment, South Farnborough, Hants. Requests for forms should be made by postcard, quoting the appropriate reference number and the posts ("a," "b," "c," etc.) for which it is desired to apply.